GRT SPORT

User's Guide and Reference

Rev. C
3-24-08

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INTENTIONALLY BLANK

FORWARD

Welcome to Grand Rapids Technologies' GRT Sport! We are pleased that you have chosen our product to meet your flying needs.

Visit the Grand Rapids Technologies (GRT) website (**www.grtavionics.com**) for the latest updates and supplemental information concerning the operation of this and other GRT products.

This manual describes the operation of GRT Sport EFIS using the software version shown in the Record of Revisions. Some differences may be observed when comparing the information in this manual to other software versions. Every effort has been made to ensure that the information in this manual is accurate and complete. GRT is not responsible for unintentional errors or omissions in the manual or their consequences.

Information in the document is subject to change without notice. Grand Rapids Technologies reserves the right to change or improve their products and to make changes in the content of this material without obligation to notify any person or organization of such changes or improvements.

CAUTIONS

WARNING: Obstacle clearance is not assured in Synthetic Approach Mode.

WARNING: Various functions of this system may be incomplete or untested. Please exercise caution when using the EFIS until a software update and a user manual corresponding to the software version are provided.

CAUTION: If any display unit is inoperable, the display units will not be able to swap information. The pilot must account for this down-graded mode of operation and expect data will transfer between displays.

CAUTION: If GPS position data is lost for more than 30 seconds, the EFIS Sport issues a **No GPS Position** warning and automatically reverts to dead-reckoning using the AHRS heading, true airspeed, last known winds and time. This data is used to estimate changes in position, which are applied to the last known GPS position to give an approximate navigation solution. The accuracy of the dead-reckoning function will degrade with time depending on the accuracy of this data and changes in the winds.

CAUTION: When the ground track indicator is hollow, indicating it is display-limited, the ground track indicated is necessarily inaccurate. This means the aircraft's track over the ground is not as indicated and the pilot should be aware of this inaccuracy with regard to obstacle and terrain clearance.

ACCESSORIES AND PACKING LIST

Your EFIS has been carefully inspected and packaged and includes the Display Unit (DU) and associated accessories. Before installing and getting started with your new system, please use the packing list that accompanied the DU and the following paragraphs to ensure that no items are missing and that there is no visible damage. If any parts are missing or damaged, please contact GRT, Inc. or your GRT, Inc. dealer immediately.

Standard Package (Single Display)

There are two DU models, S200 (Primary Flight Display-PFD) and S100 (Multi Function Display-MFD).

The S200 contains an internal Attitude, Heading Reference System (AHRS) and Air Data Computer (ADC). It is identified by the rear panel label and also by the presence of Pitot / Static connections.

The S100 does not contain an AHRS or ADC. It is identified by the rear panel label and lack of Pitot / Static connections.

Packaged with each DU is

- Magnetometer (S200 only)
- Wiring Harness
- USB Memory Stick
- User's Guide and Reference Manual
- Installation Manual

Optionally, either S200 or S100 may be equipped with Moving Map / Internal GPS and/or Engine Monitor / EIS.

Packaged with Moving Map / Internal GPS DUs is a GPS antenna.

Packaged with Engine Monitor DUs is

Engine Information System (EIS) Computer
Four (4) or Six (6) Exhaust Gas Temperature (EGT) Probes
Four (4) or Six (6) Cylinder Head Temperature (CHT) Probes
Oil Temperature Probe
Oil Pressure Probe

Dual Display Package

The GRT Sport dual display package includes a S200 and a S100, equipped with Moving Map / Internal GPS option and Engine Monitor option. Accessories included are as described above.

NOTE: The current software version comes installed from GRT, Inc. Any product or software updates can be found on the Grand Rapids Technologies, Inc. website at www.grtavionics.com.

WARRANTY

1-year “Satisfaction” Guarantee

If for any reason you are unhappy with your GRT product, you may return it for a full refund anytime in the first year you own it.

Limited Warranty

All GRT products include a 2-year warranty starting on the day the instrument is put into service (or 3 years after purchase, whichever comes first) against manufacturer defect.

RECORD OF REVISIONS

Rev	Date	SW Rev	Change(s)
A	11-27-06		Initial Release
B	4-1-07	2b	Extensive
C	2-22-08	3f	Extensive

LIST OF EFFECTIVE PAGES

Page Rev	Page Rev	Page Rev	Page Rev	Page Rev	Page Rev	Page Rev	Page Rev
ii…….C	iii…….C	iv…….C	v…….C	vi……C	vii……C	viii……C	
1-1….C	1-2…..C	1-3…..C	1-4…..C	1-5….C	1-6…..C		
2-1….C	2-2…..C	2-3…..C	2-4…..C	2-5….C	2-6…..C	2-7……C	2-8…..C
2-9….C							
3-1….C	3-2…..C	3-3…..C	3-4…..C	3-5….C	3-6…..C	3-7……C	3-8…..C
3-9….C	3-10…C						
4-1….C	4-2…..C	4-3…..C	4-4…..C	4-5….C			
5-1….C	5-2…..C	5-3…..C	5-4…..C	5-5….C			
6-1….C	6-2…..C	6-3…..C	6-4…..C	6-5….C			
7-1….C							
8-1….C	8-2…..C	8-3…..C	8-4…..C	8-5….C	8-6…..C	8-7……C	
9-1….C							
10-1…C	10-2...C	10-3…C	10-4…C	10-5…C			
11-1…C							
12-2…C	12-2…C						

Chapter 1 TAKE OFF TOUR

1.1 Power Up

The GRT Sport has no On/Off switch and will start to operate once power is supplied.

Power may be applied before or after the engine is started, although it is preferable to do the latter. This assures stable conditions and normal system behavior during power up. About 10 seconds is required for the display unit(s) to start up and a similar time for the AHRS and ADC to complete initial alignment.

Aircraft movement is allowed during initial alignment, although this motion will significantly extend the time until attitude and/or heading data is accurate, thus making it preferable to remain motionless during the first 10 seconds after power is applied.

After power-up, the startup screen (Fig 1-1) will show software and navigation database version and GRT system status.

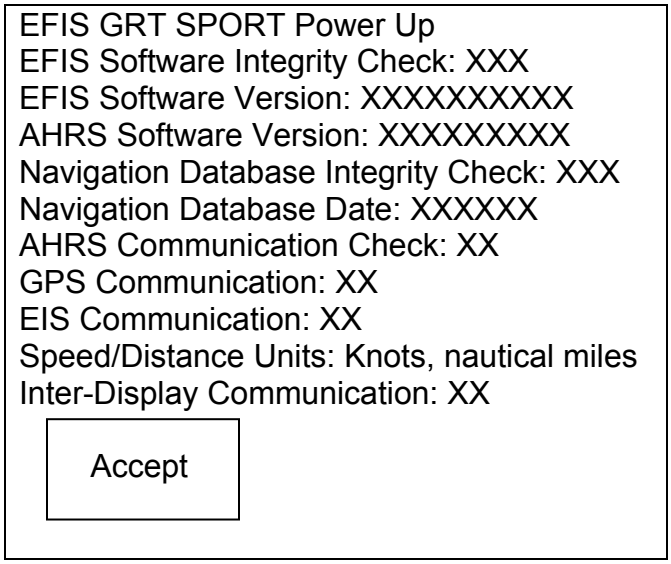


Figure 1.1 Startup Screen

To acknowledge the database information
Press the button labeled **ACCEPT**

Once acknowledged, the default screen appears (the default screen is a setup option – see GRT Sport Set Up Manual)

Note: The factory default screen is the Primary Flight Display (PFD).

1.2 Knobs and Buttons

The GRT Sport system is designed to make its use and operation simple. The left and right knobs and five white buttons are used to access the many features in the EFIS. Menu option labels show functions for each knob and button.

Knobs
The two knobs have two motions, rotary and push. These provide particular functions on different pages. (The knobs may also be called rotary encoders.)

Figure 1.2 Labels

Buttons

There are five buttons. Pressing any button will display the corresponding menu options for that page. (The buttons may also be called SoftKeys. They correspond to particular software functions within the GRT Sport.)

Menu Option Labels

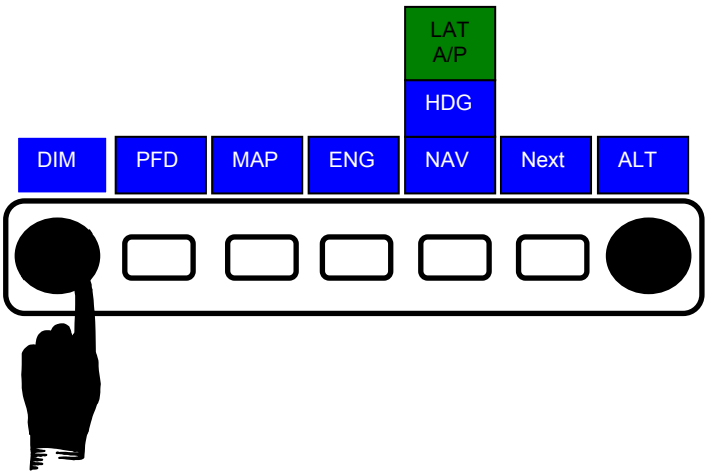
Labels are blue boxes over the knobs or buttons and describe the function for that page.

Labels appear when a knob or button is pressed and disappear after 4 seconds, unless another knob or button is turned or pressed. To keep the labels displayed press the left knob once before making any other selections. Pressing **EXIT** will hide the labels once again.

The selected or active feature is in a white border while others are within a black border.

Screen Brightness

To adjust the screen brightness:
Press the left knob, select **DIM**. Turn the knob to adjust.



1.3 Primary Flight Display Group

Single DU Primary Flight Display-PFD systems have selectable pages (dual DU systems have selectable pages only on the Multi Function Display-MFD). Using the button labeled **PFD**, you may select the PFD page or one of three split pages; PFD/MAP Arc (Moving Map required), PFD/HSI (SL30 required), or PFD/Engine (Engine Monitor required).

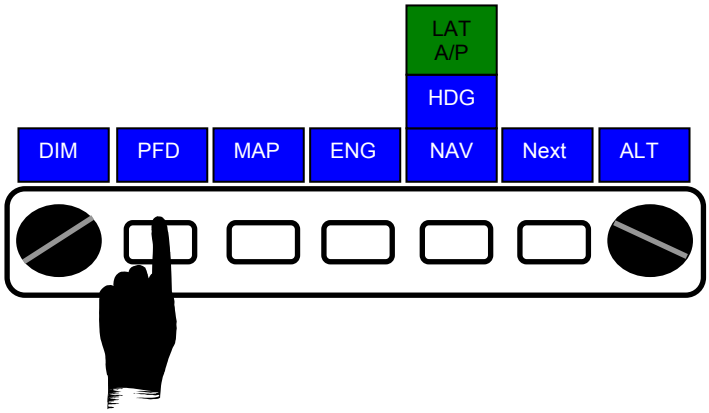


Fig. 1.3 PFD Select

The GRT Sport **PFD** (Fig 1.4**)** is the main page used during flight. It displays the basic six flight indicators and other information. Displayed is:

- Artificial Horizon
- Airspeed Tape & Indicator
- Altimeter Tape & Indicator
- Turn Coordinator
- Vertical Speed Indicator
- Heading Indicator
- User Definable Fields
- Heading Select Display
- Flight Track Marker
- Baroset Select Display
- GPS CDI Display
- Wind Indicator
- Ground Track and Waypoint Bearing Indicators
- Flight Path Marker
- Artificial Runways

Fig. 1.4 PFD Screen

FIG. 1.5 PFD/MAP Arc

FIG. 1.6 PFD/HSI

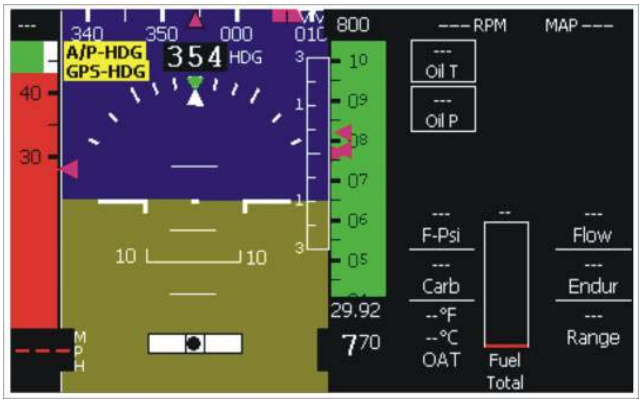


FIG. 1.7 PFD/Engine

1.4 Moving Map Group (GPS option req'd)

The GRT Sport moving **MAP** group consists of four pages: North-up, Arc, 360^0 and HSI (SL30 required). Displayed are:

- Navaids
- Airports/Airspace
- Heading or Track
- GPS waypoint/route data
- XM Weather (optional-GRT Weather required)
- Traffic (optional-GX330 transponder required)
- Wind Direction and speed
- Autopilot settings
- Terrain Clearance
- Altitude Intercept Arc

The **Map** group also contains the following subgroups:

- Flight Planning
- Checklist
- Map Slew
- Log Book

Pages within the **MAP** group are selectable by using the button labeled **MAP**. Pressing the button cycles the Arc, 360^0 and North-up pages. The HSI page is available only when a Garmin SL30 is connected.

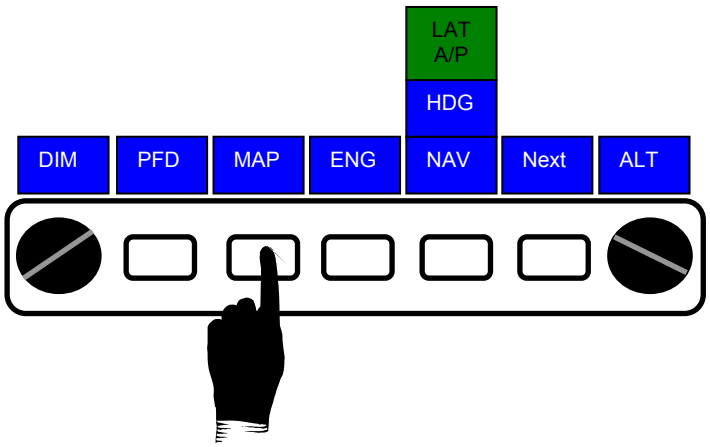


Fig. 1.8 MAP Select

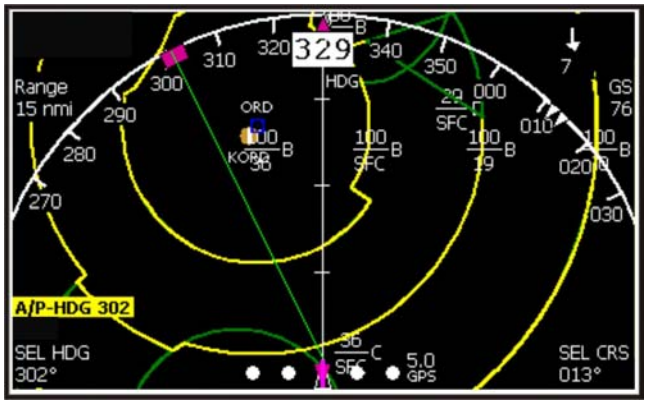


FIG 1.9 Arc

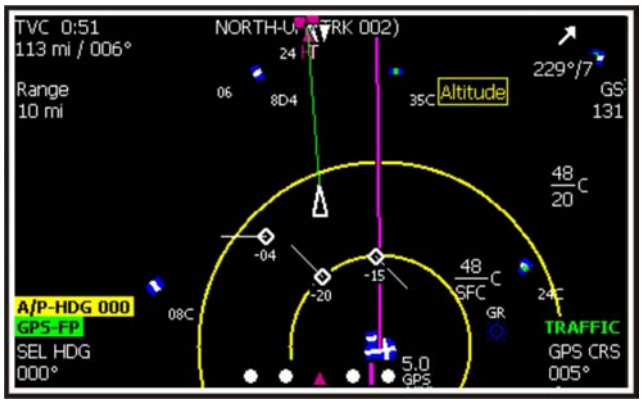


FIG. 1.10 North-Up

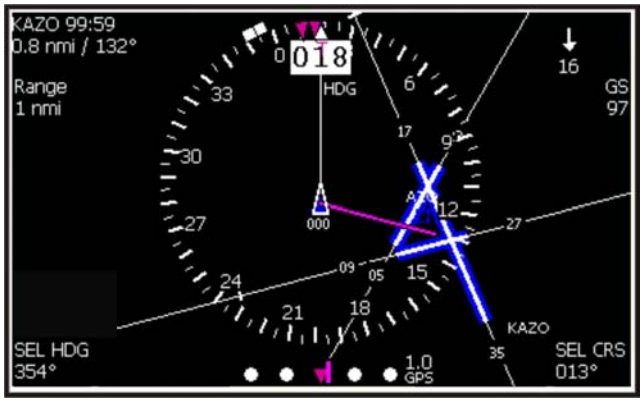


FIG. 1.11 360^0

Fig. 1.12 EHSI

1.5 Engine Group (EIS option req'd)

The GRT Sport **ENG** group may display full screen engine information or split screen ENG/MAP Arc. Use the button labeled **ENG** to switch views.

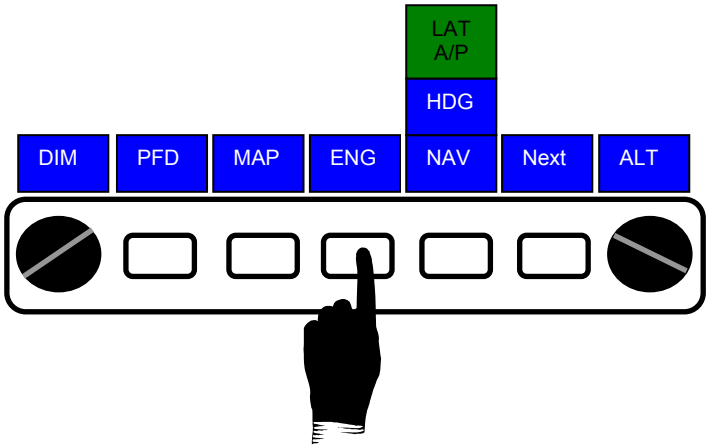


Fig. 1.13 ENG Select

The GRT Sport **ENG** page displays engine parameters in a variety of user selectable graphics. Parameters displayed include:

- Revolutions per Minute (RPM)
- Manifold Pressure (MAP)
- Oil Temperature/ Pressure
- Voltage/Amps
- Cylinder Head Temperature
- Exhaust Gas Temperature
- Fuel Flow/Pressure
- Coolant Temperature
- Carburetor Temperature
- Turbine Inlet Temperature
- N1/N2
- Lean Function
- User Defined Parameters

There are six different graphic displays within the **ENG** group that are selectable by using the button labeled **DATA**. Details of each display are in Chapter 5, Engine Monitor.

Fig. 1.14 Engine - TEMPS

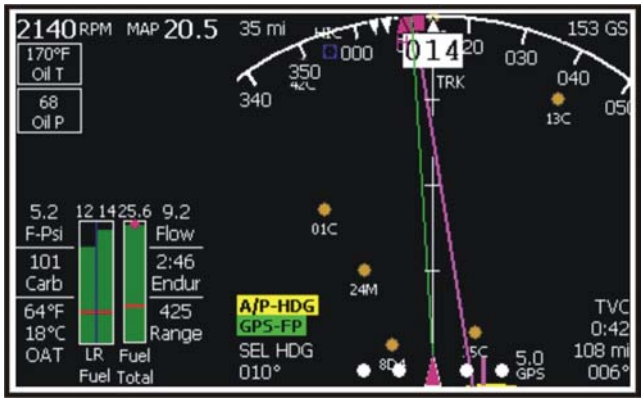


Fig. 1.15 Engine/ Map Arc

1.6 Group Options

To select options within a particular group use the **NEXT** button.

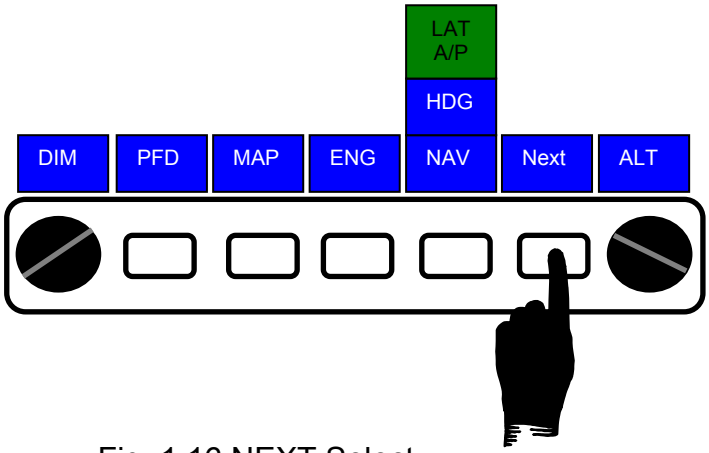
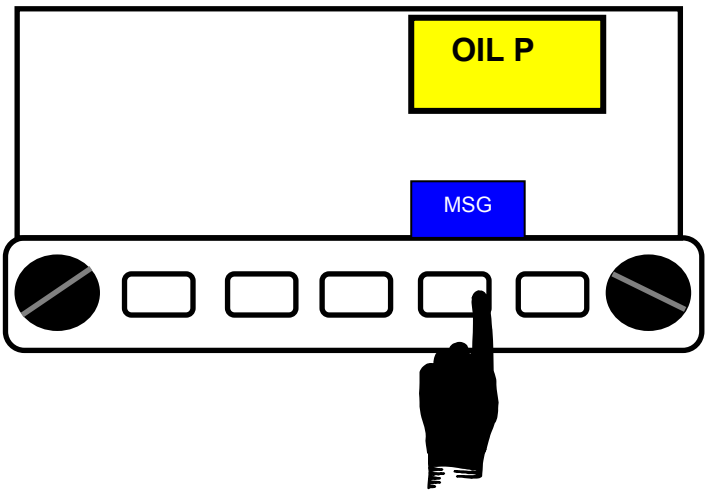


Fig. 1.16 NEXT Select

1.7 Messages

When a parameter is out of limit or a flight condition needs attention, the Sport EFIS will annunciate the problem(s) on the display and with a **MSG** label.. For example,



1.17 Out of Limit Message

Messages are displayed on the all group pages. Options to remedy the annunciation are available by pressing the button labeled **MSG**. See Chapter 6 for more details.

Chapter 2 FLIGHT DISPLAY

In this section we will show you the symbology and function within the Primary Flight Display. At first glance it looks like a lot of information, you're right, but in a short amount of time you will be able to use every feature with ease.

2.1 Using the Primary Flight Display

Below is the basic PFD page.

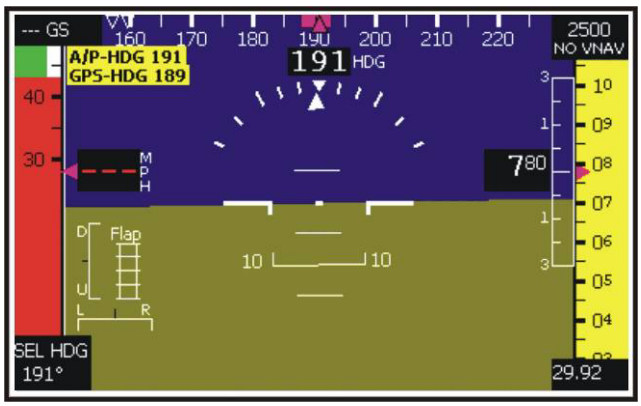


Fig. 2-1 PFD Screen

The basic PFD page consists of the primary flight instruments:

- Artificial Horizon
- Altimeter Tape with Digital Display
- Airspeed Tape with Digital Display
- Heading Tape with Digital Display
- Vertical Speed Indicator

These are arranged with the Artificial Horizon in the center, the Airspeed Tape on the left, the Altimeter Tape on the right, the Heading Indicator along the top and the Vertical Speed Indicator next to the Altimeter.

You will also notice the Pitch Ladder and Bank Angle Indicators in the center of the screen, and the Trim/Flap Indicator in the lower left (under the Airspeed Digital Display).

The basic PFD page also contains five boxes which display:

- Ground or True Airspeed - upper left
- NAV Mode Status – upper left below speed
- Heading Select - lower left
- Altitude Select/Status - upper right
- Altimeter/Baroset Setting - lower right

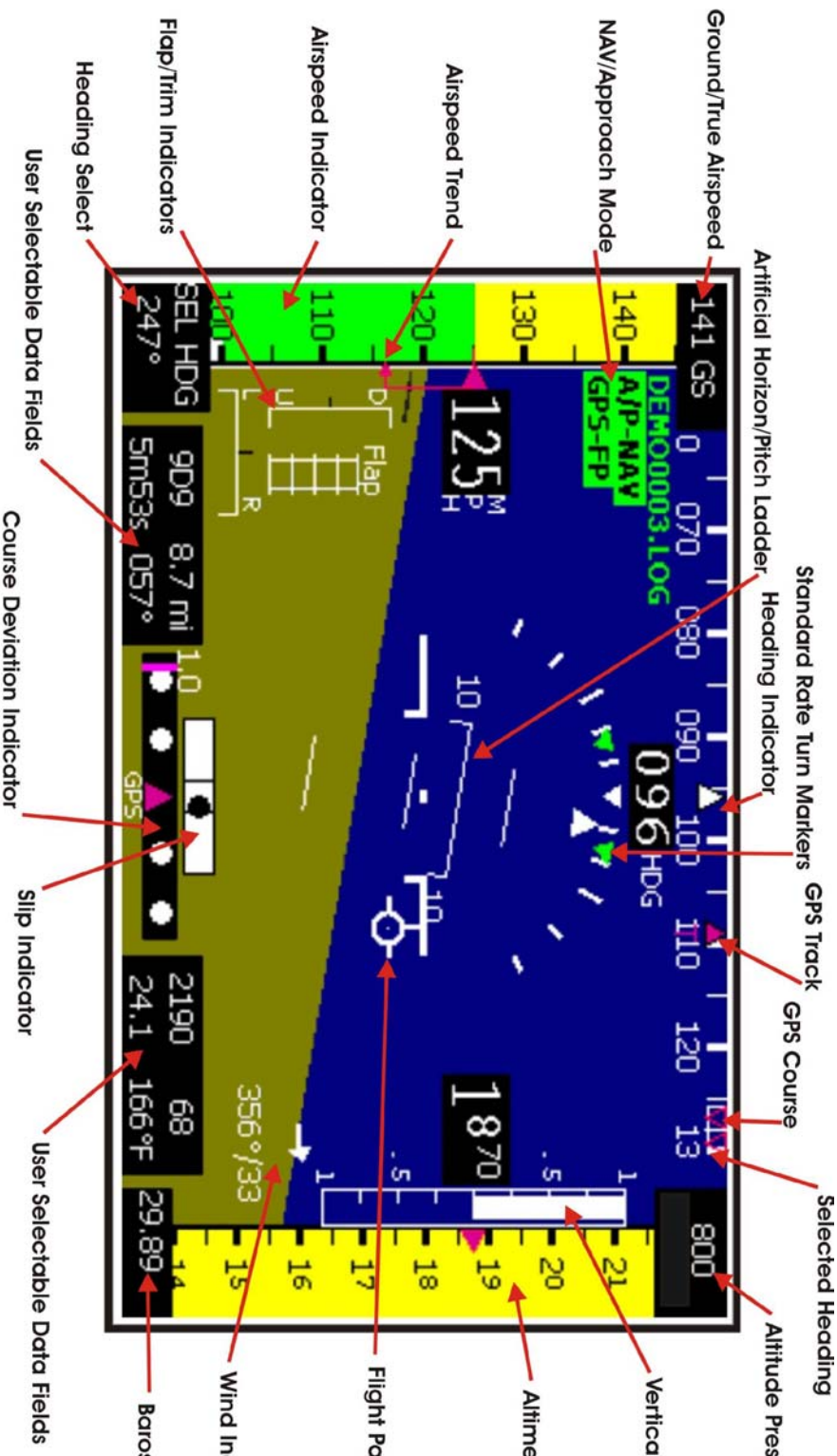


Fig. 4-2 Full Featured Primary Flight Display

2.2 Artificial Horizon

The Artificial Horizon is just that, a pictorial representation of the earth. The blue portion represents the sky; the brown portion represents the ground.

A portion of the artificial horizon is the Pitch Ladder. It depicts pitch angle of the aircraft in relation to the horizon. It is normally set **(SET MENU, Primary Flight Display, Pitch Ladder Offset**) so that straight and level flight at normal cruise speed is 0 pitch (bars align with the horizon).

The Flight Path Marker, shown as a circle with three spikes is a projection of the aircraft's flight path and predicts the future position of the aircraft based on current aircraft state parameters (attitude, speed, wind etc) and assumes they remain constant. The FPM will appear to float about the display as the aircraft pitches and rolls. This movement is most evident in strong crosswind or unusual attitudes.

2.3 Airspeed and Altimeter

The Airspeed tape displays airspeed and three user selectable speed bugs which appear as blue horizontal lines on the airspeed tape. The Bugs are set in the **SET Menu, General Setup, Primary Flight Display**.

The background color of the airspeed tape are the standard airspeed color segments (white-stall speed (Vs) to flap extension speed (Vfe); green- stall speed (Vs) to maximum structural cruise speed (Vno); yellow-maximum structural cruise speed (Vno) to never exceed speed (Vne))

Between the airspeed tape and window is the trend indicator. This is a red arrow that indicates the direction and rate of airspeed change and points to the airspeed the aircraft will be at in 5 seconds.

The Altimeter Tape displays altitude above mean sea level (MSL) in hundreds of feet. The background color of the altimeter tape shows the Off Route Obstacle Clearance Altitude (OROCA) which provides 1000 foot obstruction clearance in non-mountainous terrain areas and 2,000 foot obstruction clearance in designated mountainous areas within the United States. An altitude below the OROCA is shown yellow, above the OROCA is shown green.

To set the barometric pressure value on the altimeter:
Turn the right knob on any **PFD** page. When the desired barometric value is displayed in the lower right corner, press the knob to enter.

You may set an altimeter bug on the altimeter tape to provide a visual alert of an important altitude. It will display as two magenta triangles.

To set an Altitude bug:

1. Press the right knob on any **PFD** page.
2. Turn knob to desired Altitude
3. Press knob to set.

Just to the left of the altimeter tape is the vertical speed tape. It shows vertical speed in feet per minute.

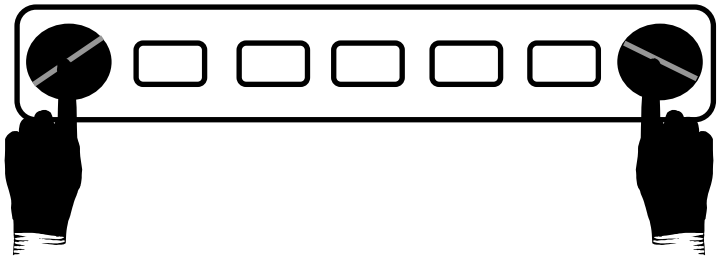
2.4 Heading

The Heading Tape displays magnetic heading, GPS ground track, GPS waypoint

bearing (or course) and heading bug. Current heading is displayed over the triangle at the center of the screen.

Ground track derived from GPS data is displayed as a triangle with a “T” written below it. Its position relative to the heading indicates the current difference between ground track and heading.

A heading bug is provided. It is useful to manually control the autopilot or as a visual reminder of desired heading. The heading bug displays as two side by side squares on the heading tape and also in the data box above the left knob. It may be set by turning the left knob on a **PFD** or **MAP** page to the desired heading. To select the current heading, press both knobs simultaneously.



Should the selected heading be off the heading tape (more than 30 deg left or right), the heading bug squares will become hollow to indicate that it is “display limited”.

The waypoint bearing (or GPS course) indicator displays as two inverted triangles on the Heading Tape and indicates the bearing (or course) to the selected GPS waypoint. Aligning the ground track indicator with this indicator will result in a ground track directly to the waypoint.

The indicators (triangles and squares) will be either white or magenta. White means that indicator is **NOT** coupled to the autopilot, and magenta means it **IS** coupled.

When you select LAT A/P HDG (heading) the heading bug turns magneta and the track indictor is white. When LAT A/P Nav is selected and the GPS is selected as the nav source the track indicator will be magenta and the heading bug white.

When a strong cross-wind component results in a ground track that differs from heading (drift angle) by more than 30 degrees, the ground track triangle becomes hollow to indicate it is “display-limited”. Simultaneously, the waypoint bearing indicator also becomes hollow. The relative position between these two indicators remains accurate, allowing the pilot to align these two indicators to achieve a ground track directly to the GPS waypoint in the same manner as if they were not display limited.

When the ground track indicator is display-limited, the flight path marker and ground-referenced symbols (runways and obstacles) are artificially shifted so that they remain on the screen, but in such a way that their position relative to each other is correct. This allows these items to be visible on the screen no matter how large the drift angle.

CAUTION: When the ground track indicator is hollow, indicating it is display-limited; the ground track indicated is necessarily inaccurate. This means that the aircraft’s track over the ground is not as indicated, and the pilot should be aware of this inaccuracy with regard to obstacle and terrain clearance.

If the waypoint bearing indicator is off the scale, an arrow will appear in the upper left or upper right portion of the screen

indicating the direction to turn to achieve a ground track to the waypoint.

A numeric presentation of the direction of flight is below the Heading Tape and is user selectable to **HDG** or **TRK**.

2.5 Wind Speed/Direction and Turn Coordinator

The wind speed and direction is available in two formats as described and selected in the **Primary Flight Display** settings page.

The vector representation of wind direction (the arrow drawn on the screen) shows wind direction relative to the aircraft's heading. A wind vector pointing directly up indicates a tailwind and a vector pointing to the right indicates the wind is blowing from left to right.

The numeric display of wind direction is relative to magnetic north.

If insufficient data exists for calculation of winds, the wind vector arrow, and digital data, is blanked (not displayed). Calculated winds are based on GPS ground track and groundspeed, and heading and airspeed data provided by the AHRS. Accurate winds require accurate magnetic heading and airspeed data. Calibration procedures to correct for heading and airspeed errors are provided, see Chapter 9, Calibration.

In addition to wind direction and speed, Head/Crosswind components may be displayed as well **(SET MENU, Primary Flight Display, Digital Head/Cross Wind Display).**

The Turn Coordinator is depicted at the top of the pitch ladder and below the heading window as inverted green triangles. The GRT Sport calculates the angle of bank required to make a Standard Rate turn at the current airspeed. The Turn Coordinator triangles will spread out or in as the airspeed increases or decreases.

2.6 GPS CDI Display & Slip Indicator

The GPS CDI (Course Deviation Indicator) is located at the bottom center of the screen. It displays the direction and magnitude of the GPS cross-track error. The cross-track error is the distance from the aircraft's current position to the line connecting the previous and next waypoint in the GPS flight plan. (When only one waypoint is active in the flight plan, the GRT Sport like most GPS navigation equipment will use the aircraft's position at the time the waypoint is selected as the previous waypoint position for purposes of calculating cross-track error.)

The cross-track deviation is represented by the deflection of the bar from the center of the CDI scale. A deflection to the left indicates the airplane needs to be maneuvered to the left to get back on course. The center of the CDI includes a triangle that points up or down to indicate **TO** or **FROM** the GPS waypoint respectively. Note: **FROM** indications result in reverse sensing for the deviation indicator, identical to that of a VOR type CDI indicator. This allows normal sensing when tracking outbound from a GPS waypoint.

The deviation bar and TO/FROM indicator are be displayed whenever a **GOTO** waypoint is active in the GPS flight plan.

The scaling of the CDI indicator changes automatically from 5.0 nm full scale when enroute, to 1.0 nm full scale in terminal

phase (within 30 nm of the destination), to 0.3 nm during approach phase. Approach phase can be detected by the GRT only when **Aviation** format of GPS data is provided to the GRT

The slip indicator works just like a water level slip indicator.

2.7 User Selectable Data Boxes

There are 2 Data Boxes at the bottom of the display. Each has four fields. Each field may be either data or a label. The choices are extensive ranging from GPS waypoints to engine parameters. Detailed instructions are contained in the GRT Sport SetUp Guide **(SET MENU, Primary Flight Display, Data Boxes).**

2.8 Fixed Data Boxes

There are 4 data boxes that display ground speed or true airspeed in the upper left corner, heading selection in the lower left corner, autopilot altitude selection and status in the upper right corner and the baroset in the lower right corner.

2.9 PFD Lock

The locked selection disables the selection of other display screens so that it is impossible to inadvertently select a display page that does not show attitude, airspeed, altitude and heading information. Split screens that include the PFD information may still be selected.

2.10 Trim, Flap Indicators

Aileron and pitch trim and flap position indicators automatically display on the PFD page in the lower left side. The data comes from EIS which can be configured for trim and flap position using its Auxiliary inputs.

2.11 Clock

If selected in the General Setup menu, a digital clock is displayed in the top right portion of the PFD screen. The clock automatically sets using GPS data and will show either Zulu or user selected time.

2.12 NAV Mode

This setting selects the source of data that is used to provide navigation information to the pilot on the PFD and map pages as well as to the autopilot.

The selections provided will correspond to the configuration of (what has been wired to) the system, such as internal GPS, external GPS and VOR/NAV

The Nav Mode selections are GPS1, GPS2, Nav1 and Nav2. It can be a combination of two GPSs (internal or external) and two Nav sources (external); dual SL30s, for example

For example:

GPS1 (496 GPS)
GPS 2 (Internal GPS)
Nav 1 (SL30)
Nav 2 (SL30)

The NAV mode is displayed in the upper left corner of the PFD display. Green is GPS, White is Nav 1, Light Blue is Nav 2. Yellow is Caution/Input required/Mode not fully engaged.

2.13 Synthetic Approach

Synthetic Approach (identified as SAP) mode allows the GRT Sport to provide lateral and vertical guidance to any runway contained with the EFIS navigation database that includes position data for each end of the runway. The vast majority of airports in the database have this information. Vertical and lateral guidance is provided via the highway-in-the-sky (HITS) on the primary flight display page and laterally via the course and GPS cross track deviation indicators. Only lateral guidance is provided for connected autopilots.

This feature provides the following benefits:

- Enhanced situational awareness during all landings. Especially helpful during night landings.
- Emergency means of guidance to the runway for the VFR pilot who inadvertently enters IFR conditions.
- Redundant guidance during ILS approach. The synthetic approach will duplicate the ILS approach alignment but is based on dissimilar data.
- Emergency backup to ILS receiver. Since the synthetic approach follows the same path as the ILS and this path has assurances of obstacle clearance, it could be used in an emergency when the ILS is unavailable.

Localizer Override

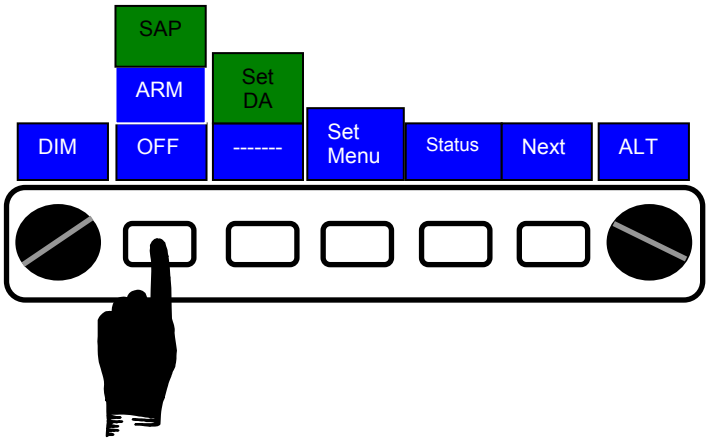
When the localizer is armed, or the nav mode is LOC, the synthetic approach mode will display the highway-in-the-sky but will not provide steering nor autopilot coupling. This is indicated by DISP selection in the SAP softkey.

Synthetic Approach Path

Lateral steering will be constructed according to the following list in order of priority:

1. If an approach has been selected on the GPS, the synthetic approach path will match the course into the runway waypoint. (An approach is a flight plan that includes guidance to the runway and will include a runway waypoint, such as RW25.)
2. If no approach has been selected on the GPS but the last waypoint in the flight plan is an airport, the pilot will be prompted to select the runway. If the runway includes a localizer in the EFIS database, then the approach will be constructed to mimic the localizer, otherwise it will be constructed to follow the extended runway centerline.
3. If no approach has been selected, and the last waypoint in the GPS flight plan is not an airport, the synthetic approach is not available.

The approach mode is selected on the primary flight display page, using the **SAP** knob. Select **SAP** to **ARM** the approach mode.



An approach will be provided if all of the following are true:

1. The last waypoint in the flight plan is an airport, and is contained within the GRT Sport navigation database, or if an approach has been selected and the GRT Sport is able to determine the airport and runway being used by the approach.

2. The database contains the necessary information about this airport, including runways, runway orientation, position, elevation, etc.

3. AHRS, Air Data Computer and GPS data are valid

The desired runway is selected turning the left knob.

The selected runway will blink yellow on the **MAP** page. This list shows the runway identifier, the length, surface (hard or soft), lighting, and crosswind component. The crosswind component is shown as X-Wind = speed L/R, where the speed is in the units selected on the GRT Sport, and the L/R indicates a left or right crosswind, such that a left crosswind indicates the wind is blowing from left to right when on the approach. The GRT Sport will list the runways in order of how closely aligned they are with the calculated wind direction. Runways that are predicted to have a greater than 10 mph tailwind are shown with a yellow background.

CAUTION: The pilot must not rely on this data for selection of the appropriate runway. Wind speed and direction is usually different on the surface. The GRT Sport is making its prediction based on its calculated winds at the time the approach mode is activated. The accuracy of the wind calculation is affected by the accuracy of the pitot/static measurements, and the calibration of the magnetometer.

After selecting a runway, it may be changed by using the **SAP** knob again. It will provide a **Chg Rwy** selection.

After selecting SAP and ARM, “Check barosetting” will be annunciated.

Once the runway and barosetting are set, the HITS will appear if able. The HITS may be behind, above or below depending on aircraft position relative to the runway.

If the selected runway includes an associated localizer in the GRT Sport navigation database, the message **Synthetic Approach using Loc Course** will be provided to remind the pilot that the approach will follow the localizer, and may

not necessarily be aligned with the runway centerline.

If the approach mode is selected, but the GPS flight plan does not contain an approach or an airport as the last waypoint that can be matched to the GRT Horizon database, then the synthetic approach cannot be activated. The GRT Horizon will respond with a message **No Airport found for Synthetic App**, and the approach mode will be turned off.

When the Synthetic Approach is enabled the height above the runway will be displayed under the Flight Path Marker in green. This altitude will flash when below the Decision Height. The Decision Height comes from database approach information, if available. Otherwise, the Decision Height setting in the SET MENU is used.

2.14 Flying the ILS

The GRT Sport, although a VFR platform, allows indication of the ILS in scales or needles format when a ILS frequency is tuned in the SL30.

To turn on needles or scales setting:

1. Press any button
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU.**
4. Scroll with either knob to **Primary Flight Display**.
5. Press knob to select
6. Scroll to **ILS Type**
7. Press knob to select and change
8. Press **SAVE** button

Chapter 3 MOVING MAP

The Moving Map page(s) provide a top-down view of the world out to the user's selected range and includes the user's defined data from the settings menu.

3.1 MAP

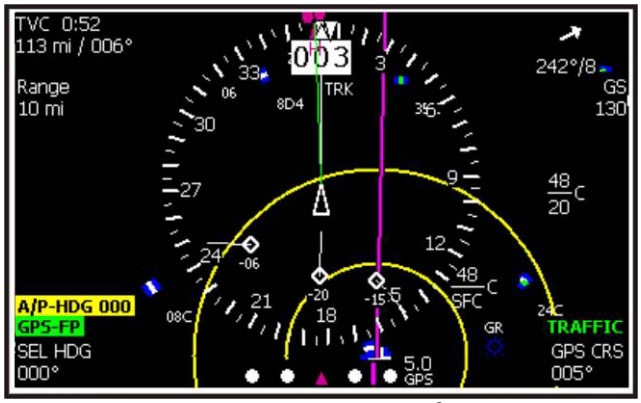


Fig.3-1 Map 360°

The **MAP** group shows:

- Airports
- Airspace
- NAVaids
- GPS/NAV Course
- Heading Select Bug
- HSI (requires SL30)
- NAV mode status
- Wind Direction and Speed
- Weather (optional)
- Traffic (optional)

The MAP display is track up or heading up according to user settings.

Pressing the **MAP** softkey will cycle the MAP through the four map view modes: Aircraft symbol at bottom of screen (Arc View), aircraft symbol in center of screen (360 deg View), North Up View and HSI which overlays an HSI over the center view map (requires SL30).

The map depicted on the GRT Sport is based on the navigation database within the EFIS. The database within an external GPS is not used, as this data is not transmitted to the EFIS.

3.2 Selecting Map Details

On any **MAP** page (not HSI page), information about navaids and airports in the database is selectable by pressing the right knob.

Fig. 3-2 Waypoint Selection

A yellow line will appear on the screen from the airplane to the item (airport/navaid) nearest the map up reference.

This item will be highlighted with a yellow circle, and basic information about it will be displayed. Rotating the knob will move the highlight to the next item nearest according to its bearing. Clockwise rotation of the knob causes the yellow line to rotate clockwise and counterclockwise rotation, the opposite.

Details for each navaid or airport, if in the database, are viewable in the Details page. The Details page will also have weather

information such as METARs if equipped with the XM Weather module and subscription.

Fig. 3-3 Map Details

To access the DETAILS function:

1. Press the right knob and
2. Turn the knob to the desired navaid or airport.
3. Press again to select **DETAILS**
4. Press again to exit back to the map page.

3.3 MAP Slew

The MAP Slew feature allows you to move the map without changing the map scale. Note that the slewed displays will be North up, however, **EXIT** returns the map as it was displayed before Slew.

To slew the MAP view:

1. Press any button
2. Press **NEXT** (more than once may be required)
3. Press **SLEW** followed by **WEST**, **EAST**, **NORTH** or **SOUTH**.
4. To return to present position press **EXIT`**

3.4 Range Select

The map view has user selectable range views from 1-1000 miles. The time it takes to display MAP data is directly related to the amount of information being displayed. Terrain slows the display significantly. So does display of airports and navaids especially at longer range views. Judicious use of user settings in the Moving Map Set Up page provides a balance of information and display speed.

To access the RNG view setting:

1. Press the left knob, the range box will highlight in yellow and show the current range selection.
2. Turn the knob to the desired viewing range.

3.5 Navigation (Flight Plan)

The GRT Sport allows for quick and easy selection of a waypoint for **Direct To** navigation or a series of waypoints for **FLIGHT PLAN** navigation. The use of the navigation features provides:

1. Graphical representation on MAP page (magenta for the segment you are currently on, white for segments planned).
2. Display of waypoint in use and associated data, such as range, bearing, ETA etc in data boxes of PFD.
3. Output of steering information to autopilot.

To access flight planning functions:

1. From any **MAP** page press any button
2. Press **NEXT** (more than once may be required)
3. Press **PLAN.** This will take you to the **DIRECT TO** page.

The center softkey toggles between **DIRECT TO** and **PLAN** modes and the current mode is displayed in the blue banner at the top of the screen.

3.5.1 DIRECT TO MODE

Note that Direct To always plans from current position to a specified waypoint. Previously defined waypoints are maintained in a library so that you can quickly recall them for reuse.

3.5.1.1 To navigate to a waypoint (airport or navaid) shown on the MAP,

1. From a **MAP** page, press the right knob.
2. Scroll to the desired waypoint.
3. Press right knob. The waypoint details will show
4. Press **ADD WP.** The waypoint will be added to the **DIRECT TO** list and be the active destination. The active destination is shown with a white arrow next to it.
1. Press **EXIT** twice to finish and return to the MAP page. Note the magenta line from the airplane symbol to the waypoint and the waypoint data box on the PFD.

3.5.1.2 To navigate to a nearby waypoint (airport or navaid):

1. Press **NEXT** (more than once may be required)
2. Press **PLAN**. This will take you to the Direct To or Flight Plan page. If not in the Direct To page, press the center softkey to toggle to it.
3. Press **NEAR**
4. Press **AIRPORT** or **NAVAID**
5. Scroll with either knob to desired waypoint
6. Press **GOTO** The selected waypoint is now the active destination in the **Direct To** page
7. Press **EXIT** twice to finish and return to the MAP page. . Note the magenta line from the airplane symbol to the waypoint and the waypoint data box on the PFD.

3.5.1.3 To navigate to a user specified waypoint (airport or navaid):

The **PLAN** page allows you to enter an airport or navaid identifier in the **DIRECT TO** page.

To enter a NEW DIRECT TO waypoint by typing the identifier:

1. Press **NEXT** (more than once may be required)
2. Press **PLAN**. This will take you to the Direct To or Flight Plan page. If not in the Direct To page, press the center softkey to toggle to it.
3. Press **NEW GOTO** from the Direct To page

Use the alpha-numeric buttons to enter the identifier for the airport or navaid.

4. Press the appropriate button to select the letter or number for each character in the identifier.

When pressing the button under a column multiple times, the cursor moves to the next letter in that column. When pressing the button under a **different** column, the cursor automatically moves to the next space in the identifier field.

The right knob controls the **NEXT** function which moves the cursor to the next space in the identifier field (needed when identifier

has two consecutive letters the same as in GRR).

The left knob controls the **CLEAR** (**CLR**) function which removes the letter or number entered and backspaces to the previous space in the identifier field.

As you enter letters or numbers, the GRT Sport can provide lists of identifiers that contain the letters and numbers entered so far. This can be helpful if you are not sure of the identifier.

The left knob also controls the **EXIT** function which returns to the Direct To page without saving the entered DIRECT TO waypoint.

When selecting an airport or navaid, the GRT Sport will automatically ask for the ICAO prefix identifier K (for North America) for the airport if it is required. If one has been entered but is not required the GRT Sport will suggest removing only the prefix identifier. A right knob selection, **REM K** will show. Similarly, if the prefix identifier K has been left off, the GRT Sport will suggest adding it. A right knob selection, **ADD K** will show. **To add or remove the prefix identifier:** Scroll to **ADD K** or **REM K** to add or remove K for the identifier.

5. Finally, press **ENTER** when complete. The selected waypoint is now the active destination in the **Direct To** page.
6. Press **EXIT** twice to finish and return to the MAP page. Note the magenta line from the airplane symbol to the waypoint and the waypoint data box on the PFD.

3.5.1.4 To navigate to a user created waypoint (Latitude / Longitude or Range / Bearing):

The **PLAN** page allows you to enter a user defined waypoint using Latitude Longitude or Range Bearing from a known reference waypoint in the **DIRECT TO** page.

To manually create a NEW DIRECT TO by Lat Long or Range Bearing:

1. Press **NEXT** (more than once may be required)
2. Press **PLAN**. This will take you to the Direct To or Flight Plan page. If not in the Direct To page, press the center softkey to toggle to it.
3. Press **User WP** (left knob**)** from the Direct To page.
4. Press **NEW.**
5. Press **CREATE** (right knob)
6. Select **LAT LON** or **RNG BRG.**
7. The left knob will step you through the data input fields.
8. When complete, press **SAVE** (right knob)
9. Press **EXIT** twice to finish and return to the MAP page. Note the magenta line from the airplane symbol to the waypoint and the waypoint data box on the PFD.

3.5.1.5 Direct To waypoint library.

When you enter a waypoint as described above, it is retained in the Direct To waypoint library. To use that waypoint again (for instance your home field),

1. Press **NEXT** (more than once may be required)
2. Press **PLAN**. This will take you to the Direct To page. If not in the Direct To page, press the center softkey to toggle to it.
3. Rotate the right knob to show the stored waypoints.

4. Select the desired waypoint (white box around it) by pressing **New Goto**. The white arrow appears to indicate that waypoint is now the active destination.
10. Pres **EXIT** to finish and return to the MAP page. Note the magenta line from the airplane symbol to the waypoint and the waypoint data box on the PFD.

3.5.2 PLAN MODE

Flight Plans always require at least 2 waypoints, the departure and destination. That is why Flight Plans may be entered prior to flight and saved for future use.

3.5.1 To enter a Flight Plan manually:

1. Press **NEXT** (more than once may be required)
2. Press **PLAN.** This will take you to the Direct To or Flight Plan page. If not in the Flight Plan page, press the center softkey to toggle to it.
3. Press **Add** or **Insert Before** (depends on position of curser within the selected Flight Plan)

Use the alpha-numeric buttons to enter the identifier for the airport or navaid.

4. Press the appropriate button to select the letter or number for each character in the identifier.

When pressing the button under a column multiple times, the cursor moves to the next letter in that column. When pressing the button under a **different** column, the cursor automatically moves to the next space in the identifier field.

The right knob controls the **NEXT** function which moves the cursor to the next space in the identifier field (needed when identifier has two consecutive letters the same as in GRR).

The left knob controls the **CLEAR** (**CLR**) function which removes the letter or number entered and backspaces to the previous space in the identifier field.

As you enter letters or numbers, the GRT Sport can provide lists of identifiers that contain the letters and numbers entered so far. This can be helpful if you are not sure of the identifier.

The left knob also controls the **EXIT** function which returns to the Plan page without saving the entered PLAN waypoint.

When selecting an airport or navaid, the GRT Sport will automatically ask for the ICAO prefix identifier K (for North America) for the airport if it is required. If one has been entered but is not required the GRT Sport will suggest removing only the prefix identifier. A right knob selection, **REM K** will show. Similarly, if the prefix identifier K has been left off, the GRT Sport will suggest adding it. A right knob selection, **ADD K** will show. **To add or remove the prefix identifier:** Scroll to **ADD K** or **REM K** to add or remove K for the identifier.

5. Continue using **Add** or **Insert Before** to insert all the waypoints.

Note that you can delete waypoints using **Del WP** over the left knob; you may insert another waypoint by pressing the **Insert Before** button; or create a user defined waypoint using **User WP** over the left knob. (see paragraph 3.5.1.4 above for

instructions on creating waypoints using Lat Long or Range Bearing)

6. Select **SAVE** with the left knob, and press the knob to save the Flight Plan.

Other options include, selecting a stored Flight Plan using **Sel FP**; reversing a Flight Plan for the return flight using **Rev FP**; or clearing (deleting) a Flight Plan using **Clr FP**. All three are found over the left knob.

Selecting **Go to Leg**, moves you to that point in the Flight Plan and is used to edit the Flight Plan.

3.5.3 Other Navigation Features

In both modes there are five functions selectable using the right knob; display waypoint details, activate/deactivate PFD information (artificial horizon, airspeed and altitude), toggle between external and internal flight plans, copy flight plans and import flight plans.

To turn on PFD artificial horizon, airspeed and altitude while in the PLAN pages (for single display systems, this feature displays basic aircraft control information while performing flight planning tasks):

1. From any **MAP** page press any button
2. Press **NEXT** (more than once may be required)
3. Press **PLAN**
4. Press right knob and scroll to select **PFD**
5. Press right knob to turn on or off

To use an external source for flight plans:

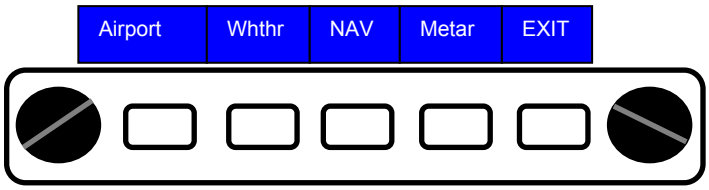
1. From any **MAP** page press any button
2. Press **NEXT** (more than once may be required)
3. Press **PLAN**
4. Press right knob and scroll to select **EXTERNAL**
5. Press right knob to view
6. Press the button labeled **COPY** to copy it to the GRT Sport

To import a flight plan (any GPS format) from flight planning software on a USB stick:

1. From any **MAP** page press any button
2. Press **NEXT** (more than once may be required)
3. Press **PLAN**
4. Press right knob and scroll to select **IMPORT**
5. Press button labeled **UP** or **DOWN** to select the desired flight plan
6. Press the button labeled **LOAD** to copy it to the GRT Sport

3.6 Nearest Function

Pressing the **NEAR** button brings up options to select the nearest airport, weather, navaid, or metar.



Searching for AIRPORT or NAVAID gives you the choice to add them as waypoint. You then may select DIRECT TO that waypoint. Selecting nearest WTHR

FREQ,or METAR allows you view METARs (XM WX required) or auto tune a selected weather frequency.

3.7 Terrain

Terrain is available on any of the three MAP pages. The GRT Sport uses the terrain database currently available on the Grand Rapids Technologies website. Go to www.grtavionics.com/download for the latest version.

To enable terrain display,

1. Press any button
2. Press the center button to toggle SHOW from NONE to TERRAIN. (Note Terrain must be enabled in the Moving Map Set Up page).

The colors displayed correspond to terrain as follows:

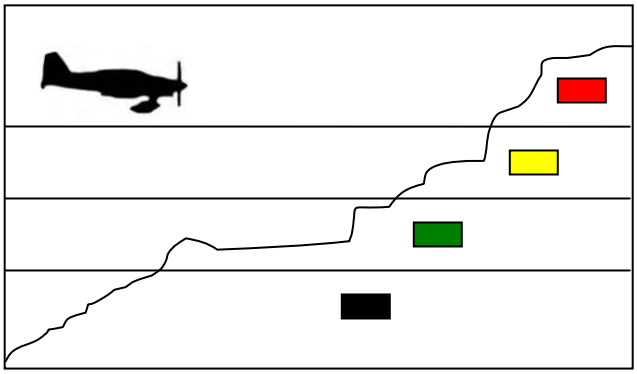


Fig. 3-4 Terrain Illustration

RED, terrain is above or within 500 ft below.
YELLOW, terrain is 500 to 1000 ft below
GREEN, terrain is 1000 to 2000 ft below
BLACK, terrain is more than 2000 ft below
BLUE DOTS, terrain in not available or has not loaded.

3.8 XM Weather (XM Weather Module Required)

XM Weather is an optional feature of the GRT Sport. When equipped the **MAP** page will show precipitation, lighting, meteorological conditions, METARs and AIRMETS according to your XM subscription. (GRT Weather module and XM Weather service required).

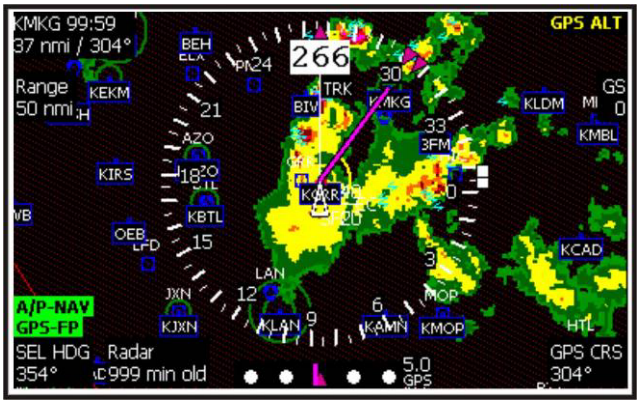


Fig. 3-5
XM Weather - IFR Conditions

3.9 Traffic (Garmin GTX330 Required)

The MAP page is capable of displaying traffic if a Garmin GTX330 Transponder is connected to the GRT Sport. Traffic targets are displayed as diamonds with direction of flight and separation in hundreds of feet.

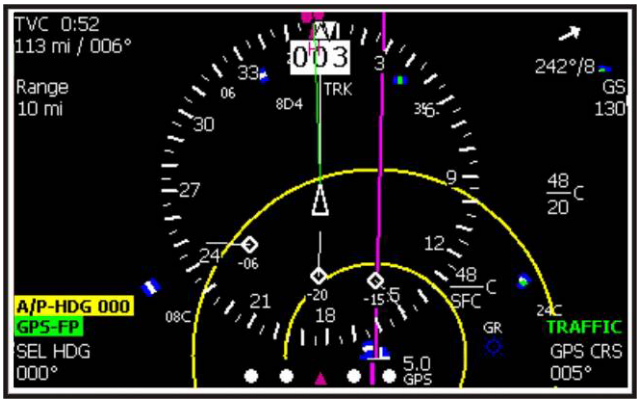


Fig 3-6 Traffic

3.10 Auto-Tuning (Garmin SL30/40 Required)

The GRT Sport's auto tune feature allows you to **SEND LIST**, **SET COM** or **SET NAV** frequencies quickly and easily.

To send a frequency list or set a com or nav:

1. Press any button, followed by **MAP**
2. Press the right knob to **SELECT DETAILS**.
3. Use the right knob to scroll through the nearest airport or navaid,
4. Press the knob to select the airport or navaid.
5. Use the sofkeys to **SEND LIST**, **SET COMM** or **SET NAV**

This feature will then program your com or nav with the selected frequency in the standby mode. To use the standby frequency set it to active in the SL30/40.

3.11 Electronic Horizontal Situation Indicator (Garmin SL30 Required)

The Horizontal Situation Indicator (HSI) works just like a conventional HSI and is displayed in the **MAP** group when the GRT Sport is connected to a Garmin SL30.

Fig 3-7 EHSI

3.12 Clock

If selected in the General Setup menu, a digital clock is displayed in the top right portion of the MAP screen. The clock uses GPS for accuracy and will show either Zulu or user selected time.

3.13 Checklists

In the **MAP** group the EFIS also provides customizable checklists.

On your home pc write a notepad file. It must be saved as a .txt file (standard notepad format) and titled CHECKLIST.txt. Checklist format is as follows:

list NAME OF LIST #1
item ITEM #1
item ITEM #2
item ITEM #3

list NAME OF LIST #2
item ITEM #1
item ITEM #2
item ITEM #3

and so on. Note that there is a space between item and ITEM.

There are also codes you can enter, such as %25% for your current oil pressure, and %53% for your current baroset, that can be used like this:

item CHECK OIL PRESSURE - %25%
item SET BAROSET - %53%

The checklist display will look like:
CHECK OIL PRESSURE 64
SET BAROSET 29.92

Codes for each parameter are as follows:

item RPM - %0%
item EGT 1 - %1%
item EGT 2 - %2%
item EGT 3 - %3%
item EGT 4 - %4%
item EGT 5 - %5%
item EGT 6 - %6%
item EGT 7 - %7%
item EGT 8 - %8%
item EGT 9 - %9%
item CHT 1 - %10%
item CHT 2 - %11%
item CHT 3 - %12%
item CHT 4 - %13%
item CHT 5 - %14%
item CHT 6 - %15%
item EIS VOLTS - %16%
item FUEL FLOW - %17%
item EIS TEMPERATURE - %18%
item CARB TEMPERATURE - %19%
item COOLANT TEMPERATURE - %20%
item HOURMETER - %21%
item FUEL REMAINING - %22%
item FLIGHT TIME - %23%
item OIL TEMPERATURE - %24%
item OIL PRESSURE - %25%
item EIS AUX 1 - %26%
item EIS AUX 2 - %27%
item EIS AUX 3 - %28%
item EIS AUX 4 - %29%
item EIS AUX 5 - %30%
item EIS AUX 6 - %31%
item FUEL ENDURANCE - %32%
item FUEL RANGE - %33%
item ENGINE PERCENT POWER - %34%
item EFIS VOLTS 1 - %35%
item EFIS VOLTS 2 - %36%
item EFIS VOLTS 3 - %37%
item ANALOG AUX 1 - %38%
item ANALOG AUX 2 - %39%
item ANALOG AUX 3 - %40%
item ANALOG AUX 4 - %41%
item ANALOG AUX 5 - %42%
item ANALOG AUX 6 - %43%
item ANALOG AUX 7 - %44%
item ANALOG AUX 8 - %45%
item OAT - %46%
item INDICATED AIRSPEED - %47%
item TRUE AIRSPEED - %48%
item VERTICAL SPEED - %49%
item ALTIMETER - %50%
item PRESSURE ALTITUDE - %51%
item DENSITY ALTITUDE - %52%
item BAROSET - %53%
item AHRS ALIGNMENT - %54%
item AHRS STATUS - %55%
item AHRS ATTITUDE STATUS - %56%
item AHRS ALTITUDE STATUS - %57%
item AHRS ROLL - %58%
item AHRS PITCH - %59%
item AHRS HEADING - %60%
item AHRS SLIP - %61%
item AHRS VOLTS 1 - %62%
item AHRS VOLTS 2 - %63%
item AHRS VOLTS 3 - %64%
item AHRS TEMPERATURE - %65%
item FLAPS - %66%
item AILERON TRIM - %67%
item ELEVATOR TRIM - %68%
item ACTIVE WAYPOINT - %69%
item ESTIMATED TIME TO WAYPOINT - %70%
item RANGE TO WAYPOINT - %71%
item BEARING TO WAYPOINT - %72%
item GROUNDSPEED - %73%
item WIND SPEED - %74%

item WIND DIRECTION - %75%
item NAV MODE - %76%
item A/P MODE - %77%
item VNAV MODE - %78%
item SELECTED HEADING - %79%
item SELECTED COURSE - %80%
item SELECTED ALTITUDE - %81%

Loading CHECKLIST.TXT into the display:

1. Go to a **MAP** page
2. Push the **CHECK LIST** button
3. Push the **SELECT LIST** button
4. Push the **IMPORT** button
5. The display will look for CHECKLIST.TXT on the USB flash drive and show the list names.
6. Push **YES** to accept the new lists or **NO** to keep your previous lists, if any.

3.14 Logbook

In the **MAP** group there is an automatic logbook function which generates a logbook entry for each flight. Airspeed greater than 25 knots forces the creation of a logbook entry.

Recorded in the logbook are:
Date
Origin (Orig)
Destination (Dest)
Flight Hours (Hrs)
Fuel Used (Fuel)
Departure Time (Dep)
Arrival Time (Arr)
Engine Hours (Eng-Hr)

Additional logbook information may be added by the user include:

VFR or IFR (V/I)
Number of passengers (PAS)
Fuel Added (FA)
Oil Added (OA)

The entries will accumulate up to 200 before the EFIS will overwrite the older entries.

An **EDIT** option allows you to add information listed above.

A **DOWNLOAD** option is provided to download the entries to a spreadsheet for permanent recordkeeping and future viewing.

Chapter 4 ENGINE MONITOR

The Engine Monitor Display provides a graphical presentation of the information from sensors attached to the Engine Information System (EIS). In this section we will show you the different pages and leaning function.

Fig. 4-1 Engine Monitor

The Engine page always shows two dials (top right), up to six vertical bar graphs (bottom left) and fuel data (upper right). The bottom right area has six selectable views. They are:

- Temps (EGT & CHT vertical graphs)
- EGT (120 seconds of EGT data and EGT vertical graph)
- History (120 seconds of EGT and CHT data)
- Bars (adds up to 11 more vertical bar graphs)
- Stats (12 predefined statistics)
- Dials (adds 2 more dials)

4.1 Fuel Data

This section has two vertical bar graphs. The left one shows fuel quantity as measured by in tank fuel sensors. There is a separate bar for each tank. The number at the top of each bar is the measured quantity.

The right one shows total fuel quantity as reported by the EIS Fuel Flow option. The number at the top is the measured quantity and may not exactly agree with the sum of the other bars. Each bar may display a user set red line as low fuel warning. The right bar will also show a red diamond. This graphically shows fuel flow.

To the right of the right bar, is displayed Fuel Flow, Endurance (based on user input fuel burn rate) and Range (based on calculated Endurance and current airspeed). All these require EIS Fuel Flow option.

To the left of the left bar, is displayed Fuel Pressure; user choice of Carb temp, TAS, or MPG/KPL; OAT in both deg c and deg F.

4.2 Vertical Bar Graphs

Up to six user selectable vertical bar graphs may be displayed in this area. Each shows the numeric value of the parameter at the top and each may have red lines and green “arcs”. By manipulating the start and end points, it is possible to arrange them so the green area would be half way up during normal operation . This arrangement makes it easy to quickly verify that all parameters are normal.

4.3 Dials

Up to four dial displays are user configurable. The top two always show.

Flight time (this flight) displays at the top between the two dials. Percent power as determined by the Engine Performance chart is displayed at the bottom between the two dials. Total logged time is displayed to the right of the right dial .

4.4 TEMPS Page

The Temps page shows CHT and EGT temperatures.

Fig. 4-2 Temperature Page

To access the TEMPS page:

1. Press a button
2. Press the **DATA** button to select **TEMPS**

4.5 EGT Page

The **EGT** page shows Exhaust Gas Temperatures and is useful for leaning. The page provides 30-240 user selectable seconds of CHT and EGT history.

To select the time to be displayed:

1. Press the right knob
2. Rotate to select 30, 60, 120 or 240 seconds of data.
3. Press the right knob again to accept.

The picture below shows the **EGT** page with the **LEAN** function **OFF**. The last 120 seconds of EGT data is plotted, graph color corresponding to cylinder color.

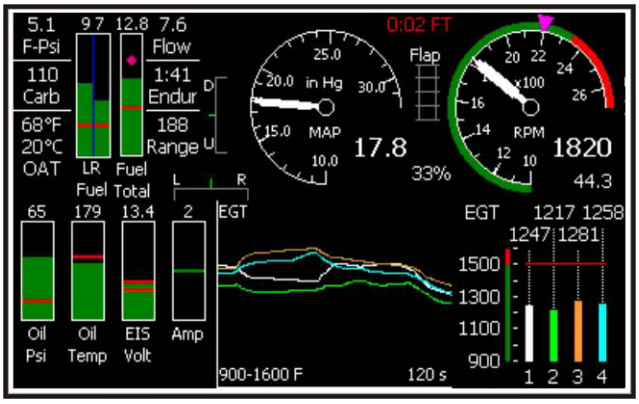


Fig. 4-3 EGT Page-LEAN OFF

To access the EGT page:

1. Press a button
2. Press the **DATA** button to select **EGT**

With the **LEAN** function set to **LEAN, as you lean your engine** the EGT page will show the first cylinder to peak surrounded by a white box. The number will change from EGT to a delta temperature indication when more than 10 degrees from peak. As you continue leaning, the last cylinder to peak will be shown in a green box and show a delta temperature from peak. Continuing to lean will show the delta temperature from peak; for example -50.

If you then enrichen, the Lean Function will show a new peak temperature for the first and last cylinder (same as above) and then delta temperature from peak. You will be on the rich side of peak however the number will show a minus (-) number since the EFIS does not know the mixture position or what side of peak you are on.

To access the LEAN function:

1. Press a button
2. Press **LEAN** button to select **LEAN**, **NORM** or **OFF**

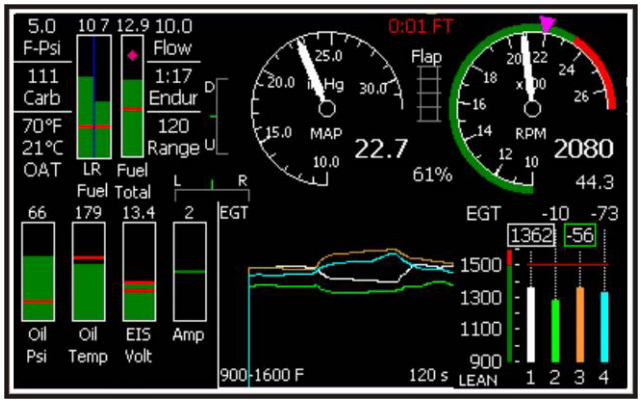


Fig.4-4 EGT Page-LEAN LEAN

The **LEAN NORM** function shows the difference between the cylinder temperatures from the time the **NORM** function is pressed.

The **LEAN LEAN** function shows the cylinders peak from first to last and their temperature difference from that point in time.

Fig. 4-5 EGT Page LEAN NORM

4.6 HIST Page

The Engine History page provides both CHT and EGT history. The page provides 30-240 user selectable seconds of CHT and EGT history.

To select the time to be displayed:

1. Press the right knob
2. Rotate to select 30, 60, 120 or 240 seconds of data.
3. Press the right knob again to accept.

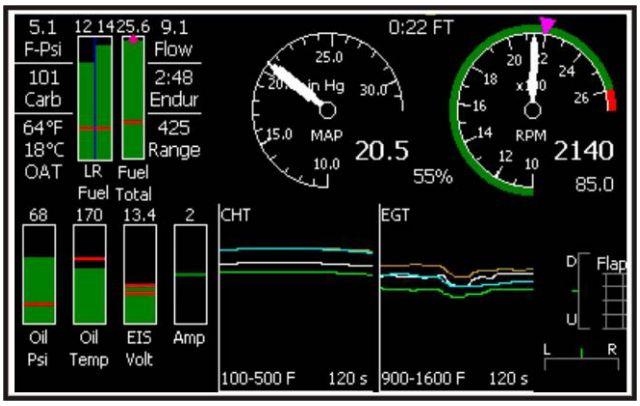


Fig. 4-6 Engine History

4.7 STATS Page

The Engine Stats page provides a quick reference area for a number of different parameters.

Fig 4-7 Engine Stats

4.8 DIALS Page

The Engine Dials page allows certain parameters to be viewed in a dial format. Below is an example of this page view.

Fig. 4-8 Engine Dials

4.9 Split ENG MAP Page

It is also possible to view the Engine page and the Moving Map at the same time. Fuel Data will be displayed as well as up to 11 user defined parameters and an abbreviated MAP Arc page.

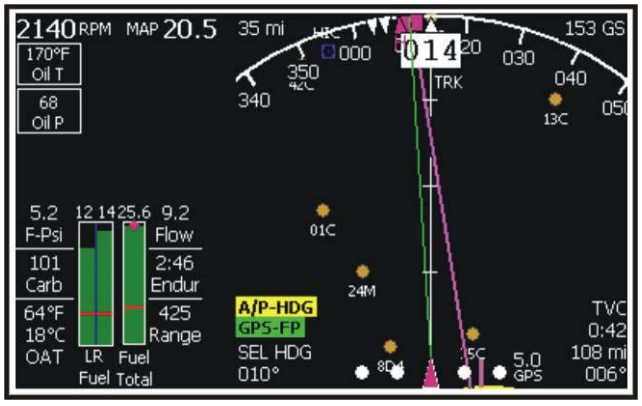


Fig. 4-9 Engine/Map

To access this view:

1. Press any button followed by **ENG**

Split pages are only available on the S100 Map/Engine display. The S200 will only show the PFD.

4.10 Fuel Totalizer

The EIS Fuel Flow option includes an accurate Fuel Totalizer. Since fuel flow is accurately measured, it is easy to calculate how much fuel has been consumed.

The pilot must update the totalizer so that the amount of fuel on board at the start of the flight is accurately known.

To access the Total Fuel function:

1. Press the left knob

The **Fuel** label will show the following:

OK
(Preset number)
(Preset number)
ADJ

The **OK** option will not make any changes. The top number and the one below it are fuel totals.

The top number is adjustable by selecting **ADJ**. When changed and accepted this new number will be kept in memory till it is changed by the user.

The number below is a user preset fuel total in the **Graphical Engine Display** set menu.

These numbers allow you to display preset fuel total, leave the total as it is now, or enter a specific fuel quantity for the fuel on board to be used in Endurance calculation.

4.11 Engine Page Settings

There are two Setting Menus for the Engine Monitor Display page. The first is the

Graphical Engine Display menu. It provides settings to customize the bar graphs and dials on the **ENG** page.

To access the Engine Monitor settings:

1. Press any button
2. Press **NEXT** (More than once may be required)
3. Press **SET MENU**.
4. Select **Graphical Engine Display** with either knob then
5. Press to select.

The second is the Engine Limits menu. This page provides settings for all the parameters to be shown on the **ENG** page.

To access the Engine Monitor settings:

1. Press any button
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU**
4. Select **Engine Limits** with either knob then
5. Press to select

Chapter 5 A/P COUPLING

The GRT Sport generates lateral autopilot commands (no vertical commands) to allow coupling of GPS sources or heading to the autopilot. The data to control the autopilot is in GPS format. This requires the autopilot to be in **flight plan** mode. The GRT Sport will provide these commands even if the autopilot itself does not support these modes.

Autopilots that do not include GPSS typically include an interface which allows them to follow the GPS flight plan.

NOTE: The autopilot must be in the mode that allows it to follow a GPS flight plan as if it was connected to a GPS.

The intercept angle to the localizer is controlled by the autopilot, and will usually be fixed at 45 degrees.

5.1 Autopilot Mode

LAT A/P

The Lateral Autopilot, **LAT A/P** selection allows you to couple the lateral steering of the autopilot to the heading bug (**HDG**), or the GPS receiver (**NAV**) from the **PFD** page.

To select LAT A/P - HDG:

1. Press **PFD** button
2. Press **NEXT** button (more than once may be required)
3. Press **LAT A/P HDG**.

To select LAT A/P - NAV:

1. Press **PFD** button
2. Press **NEXT** button (more than once may be required)
3. Press **LAT A/P NAV** button

5.2 The Synthetic Approach Mode

Synthetic Approach (identified as SAP) mode allows the GRT Sport to provide lateral and vertical guidance to any runway contained with the EFIS navigation database that includes position data for each end of the runway. The vast majority of airports in the database have this information. Vertical and lateral guidance is provided via the highway-in-the-sky on the primary flight display page and laterally via the course and GPS cross track deviation indicators.

Lateral (no vertical) steering for the synthetic approach is constructed by the GRT Sport according to the following list, in order of priority.

1. If an approach has been selected on the GPS, the synthetic approach path will match the course into the runway waypoint. (An approach is a flight plan that includes guidance to the runway, and will include a runway waypoint, such as RW25.)
2. If no approach has been selected on the GPS, but the last waypoint in the flight plan is an airport, the pilot will be prompted to select the runway. If the runway includes a localizer in the GRT Sport database, then the approach will be constructed to mimic the localizer, otherwise it will be constructed to follow the extended runway centerline.
3. If no approach has been selected, and the last waypoint in the GPS flight plan is not an airport, the synthetic approach is not available.

Selecting the Synthetic Approach

The approach mode is selected on the primary flight display page, using the **SAP**

button. Select **SAP** to **ARM** the approach mode. An approach will be provided if all of the following is true:

1. The last waypoint in the flight plan is an airport, and is contained within the GRT Sport navigation database, or if an approach has been selected and the GRT Sport is able to determine the airport and runway being used by the approach.
2. The database contains the necessary information about this airport, including runways, runway orientation, position, elevation, etc.
3. AHRS/Air Data and GPS data are valid.

5.2.1 Automatic Runway Selection

If an approach has been selected in the GPS flight plan, and the GRT Sport is able to determine the airport and runway for this approach, a message will be generated confirming the runway selected by the GPS approach was identified (For example, **Synthetic App using 26L at KGRR**).

5.2.2 Manual Runway Selection

If an approach has not been selected on the GPS, and the last waypoint in the flight plan is an airport, the GRT Sport will provide a list of the available runways. The desired runway is selected using the left knob. This list shows the runway identifier, the length, surface (hard or soft), lighting, and crosswind component. The crosswind component is shown as X-Wind = speed L/R, where the speed is in the units selected on the GRT Sport, and the L/R indicates a left or right crosswind, such that a left crosswind indicates the wind is blowing from left to right when on the approach. The GRT Sport will list the runways in order of how closely aligned they are with the calculated wind direction. Runways that are predicted to have a greater than 10 mph tailwind are shown with a yellow background.

After selecting a runway, it may be changed by using the **SAP** button again. It will provide a **Chg Rwy** selection.

CAUTION: The pilot must not rely on this data for selection of the appropriate runway. Wind speed and direction is usually different on the surface. The EFIS SPORT is making its prediction based on its calculated winds at the time the approach mode is activated. The accuracy of the wind calculation is affected by the accuracy of the pitot/static measurements, and the calibration of the magnetometer.

If the selected runway includes an associated localizer in the GRT Sport navigation database, the message **Synthetic Approach using Loc Course** will be provided to remind the pilot that the approach will follow the localizer, and my not necessarily be aligned with the runway centerline.

If the approach mode is selected, but the GPS flight plan does not contain an approach or an airport as the last waypoint that can be matched to the GRT Sport database, then the synthetic approach cannot be activated. The GRT Sport will respond with a message **No Airport found for Synthetic App**, and the approach mode will be turned off.

5.2.3 Transitioning from Enroute to Synthetic Approach

If an approach has been selected in the GPS flight plan, the transition from enroute to a path that aligns the airplane with the runway will be inherent in the GPS flight plan. The synthetic approach will be considered **captured** (causing the synthetic approach HITS to be displayed) when the airplane is within 2.5 degrees of the synthetic approach course, and within 20 nm of the runway threshold, emulating the typical capture of a localizer.

If no approach has been selected on the GPS flight plan, the GRT Sport will override the GPS flight plan or HDG selection to turn the airplane onto the extended runway centerline. This will typically occur when the airplane is within 2.5 degrees of the extended runway centerline, and within 20 nm of the runway threshold. A message **Synthetic Approach Captured** will be displayed when this transition occurs, and the GPS CDI, and course indicator will then be driven by the synthetic approach, as well as the autopilot.

If capture of the synthetic approach is attempted close to the runway, the GRT Sport will try to predict when it must begin turning onto the synthetic approach course based on groundspeed and intercept angle so that it does not overshoot the course. Since the response of the autopilot and airplane can not be predicted perfectly, overshoot is possible, and some loss of accuracy in the initial tracking of the synthetic approach may be expected. The following diagram illustrates the synthetic approach capture criteria.

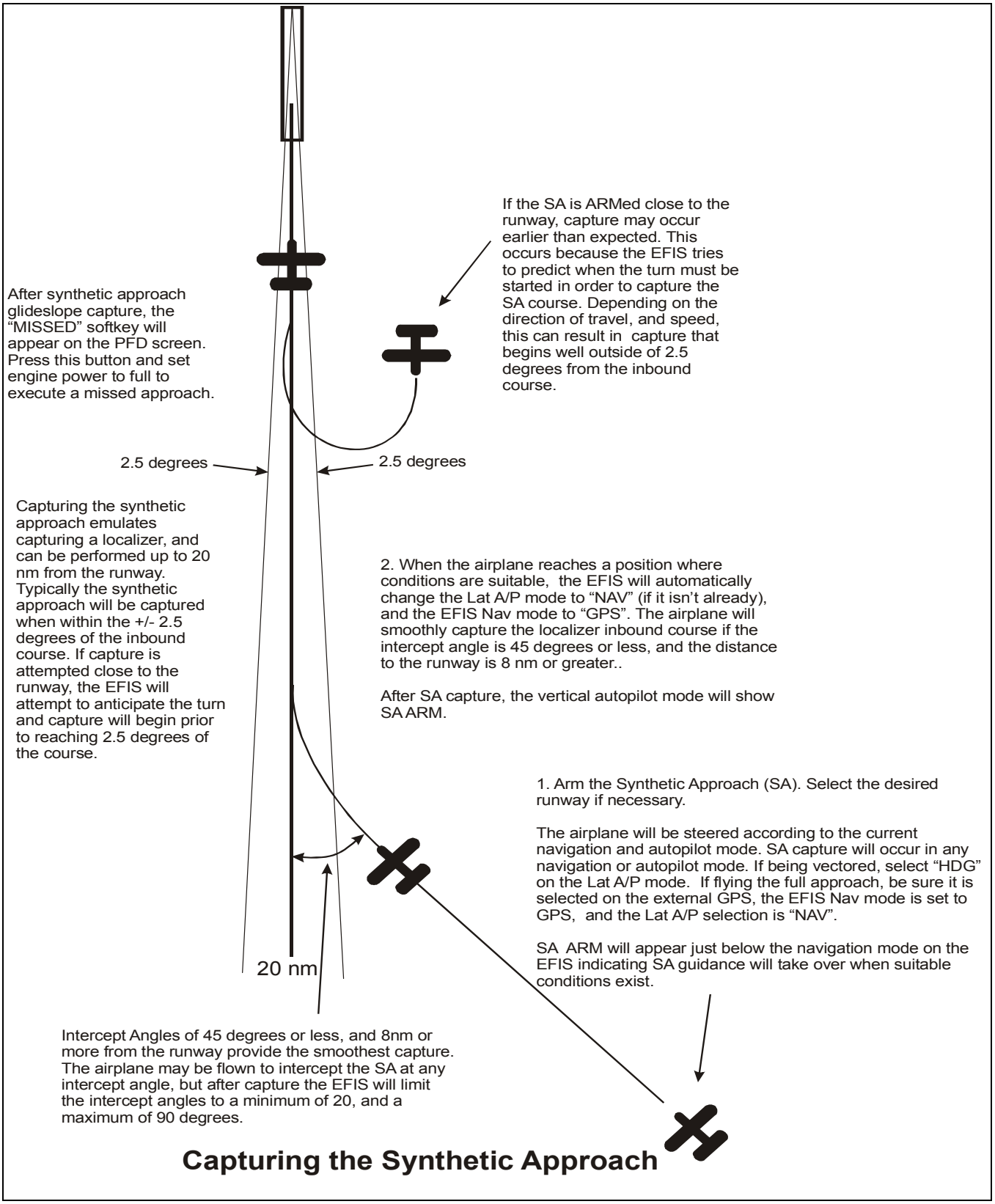


Fig. 5-1 Synthetic Approach Capture

5.3 Altitude Presets

The GRT Sport has one altitude preset, Decision Altitude.

The altitude window will show on the display and blink. Waiting 5 seconds allows the number to be changed by tens of feet.

To set the DECISION ALTITUDE:

1. Press **PFD** button
2. **NEXT** button (more than once may be required)
3. Press **SET DA** button
4. Press the right knob, **SET**

To clear a DECISION ALTITUDE:

1. Press **PFD** button
2. Press **NEXT** button (more than once may be required)
3. Press **SET DA** button
4. Press **CLEAR** button

Chapter 6 OTHER FEATURES

6.1 Swap

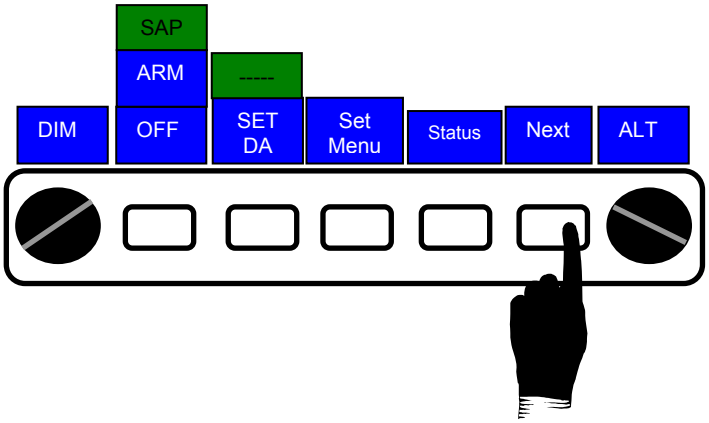
The **SWAP** feature is available in the Dual GRT Sport Package. This allows the information to be swapped from one display to other since one display unit is an S200 Primary Flight Display and the other is the S100 Engine and Map.

SWAP **ONLY** switches displays and function. It does **NOT** switch electronic circuitry and redundant electronic circuitry does not exist in GRT Sport. For example, if the electronic circuitry in the PFD unit fails, PFD information will **NOT** swap to the MFD display.

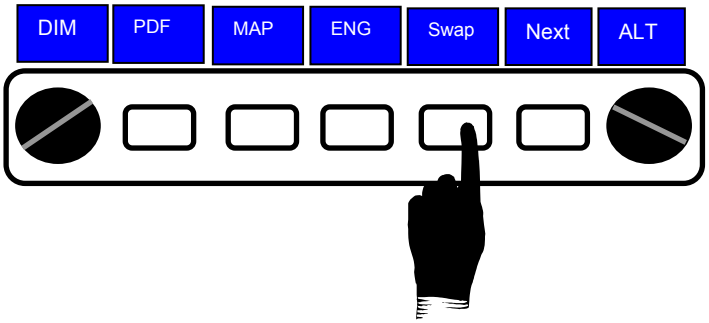
SWAP is useful if the second display is not conveniently located in front of the pilot. By SWAPing, the pilot can easily observe and enter data into the remote display and then SWAP again to restore the PFD display in front of him.

To SWAP display information:

1. Press any button or knob
2. Press **Next** (more than once may be required)



3. Press **Swap**



6.2 Power Up

6.2.1 Ground Power Up

The GRT Sport will turn on once power is supplied.

When an Aircraft On Ground (AOG) power-up occurs the startup screen will show software and navigation database version and GRT system status.

EFIS GRT SPORT Power Up
EFIS Software Integrity Check: XXX
EFIS Software Version: XXXXXXXXXX
AHRS Software Version: XXXXXXXXX
Navigation Database Integrity Check: XXX
Navigation Database Date: XXXXXX
AHRS Communication Check: XX
GPS Communication Check: XX
Speed/Distance Units: Knots, nautical miles

Accept

Figure 1.1 Startup Screen

To acknowledge the database information:

Press the button labeled **ACCEPT**

Once acknowledged the default screen appears per the user's preset selection.

Note: The factory default screen is the Primary Flight Display (PFD).

6.2.2 In Flight Power Up

An In-Flight power-up occurs when the following is true:

- *Airspeed greater than 50 mph and/or GPS-reported ground-speed greater than 25 mph.*

An In-Flight power-up will result in the display unit showing the same screen as was selected when the display unit was last powered down. The startup screen will not show.

6.3 Flight Data Recording

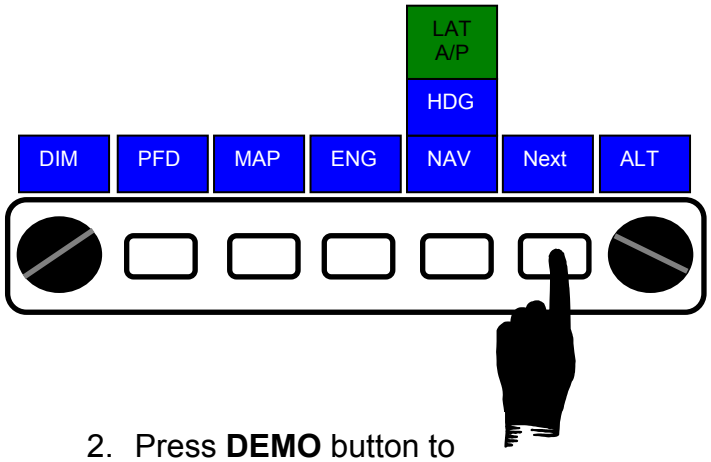
The GRT Sport allows you to record flights and engine data using the **DEMO** feature.

This feature will record flight and engine data which can be played back on the display unit. The engine data can be converted and downloaded to a spreadsheet format for analysis using the **EIS Log** software.

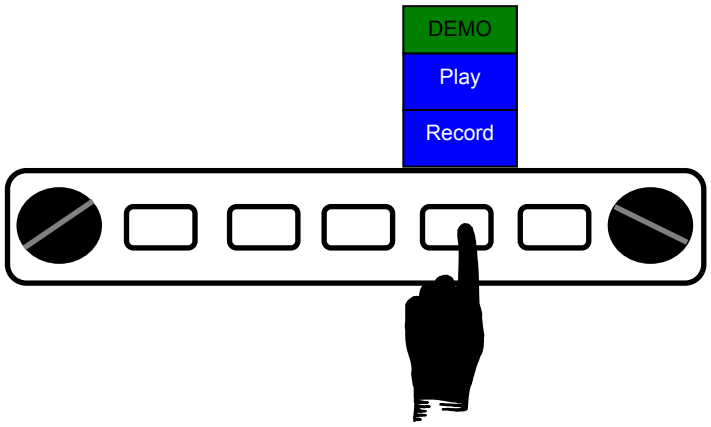
The USB memory stick must be in a MFD to record flight data.

To record a flight using DEMO feature:

1. Press any button then **NEXT** (more than once may be required)



2. Press **DEMO** button to select **RECORD.** (The recording will begin and a message will remind you to stop the recording before turning off the power to the display unit.)



3. To stop the recording locate the **DEMO** button and press **STOP**. Be absolutely certain that a memory stick is in a DU prior to pressing **STOP**. Data is written to internal memory during the flight, and is transferred to the memory stick when **STOP** is pressed.

The amount of internal memory available will affect Flight Data Recording. All data available in the system is recorded. So if Terrain, WX and airports/navaids out to max range are enabled, more data is created per

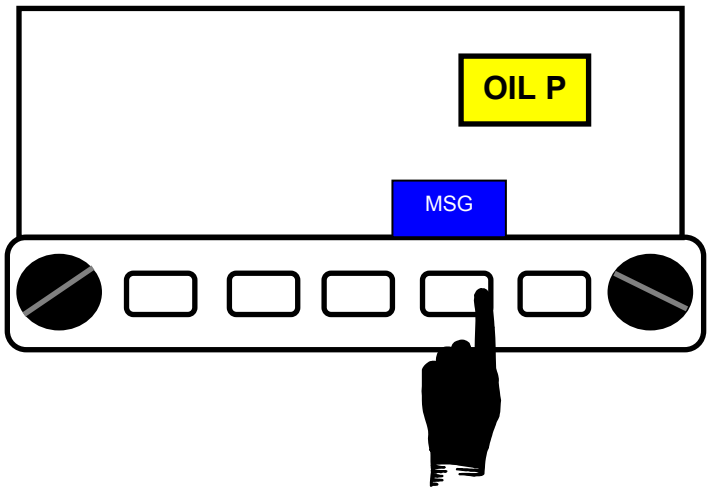
second than if those options are disabled. Since the amount of memory is limited, disabling options will allow a longer data acquisition time. The size of the memory stick only has to be larger than the internal memory.

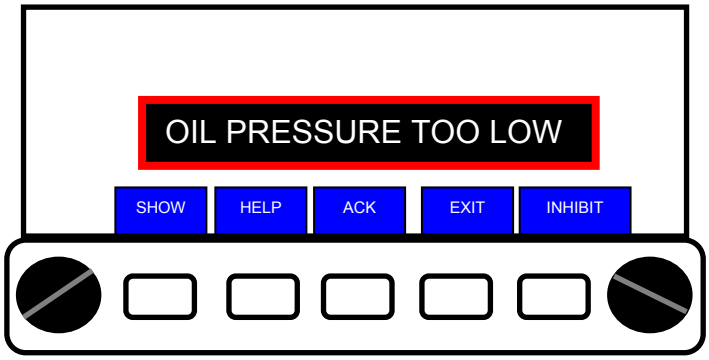
6.4 Messages

When a parameter is out of limit or a flight condition needs attention the GRT Sport EFIS will annunciate the problem(s).

These messages are displayed on the all group pages. Options are presented to remedy the annunciation by pressing the **MSG** button.

A typical message will look something like this: **OIL P** meaning oil pressure is out of limit. Pressing the **MSG** button will display options to answer the message.





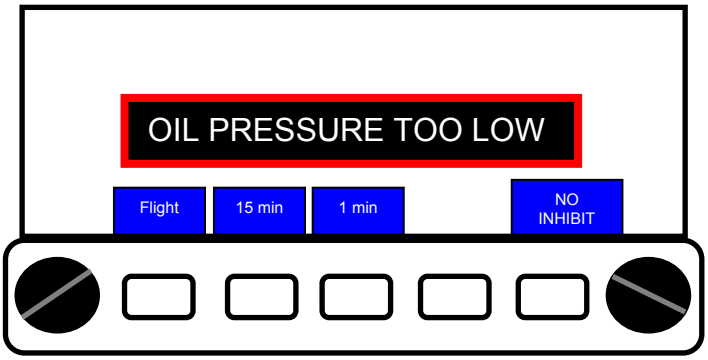
In the example the oil pressure is out of limit, too low. The EFIS will provide five options to choose from.

SHOW — pressing and holding the **SHOW** button will display the engine menu so that you can view the alarm source.

HELP — pressing and holding the **HELP** button will display a help banner.

ACK — momentarily pressing the **ACK** (acknowledge) button will make the message go away. The alarm has been momentarily silenced but will annunciate again if the parameter continues to exceed the limit.

INHIBIT — pressing **INHIBIT** will bring up more options to silence the alarm.



The **INHIBIT** options are:

FLIGHT – pressing **FLIGHT** will silence the alarm for the duration of the flight.

15 MIN – pressing **15 MIN** will silence the alarm for 15 minutes then will annunciate if the parameter is still out of limit.

1 MIN – pressing **1 MIN** will silence the alarm for 1 minute then will annunciate if the parameter is still out of limit.

NO INHIBIT – pressing **NO INHIBIT** will take you back to the previous menu.

6.5 Updating Software

The navigation database and software in GRT Sport Up are updated using the same procedure, as described below. The software updates loaded by this procedure will update the display unit software immediately, and one additional step allows any update to your AHRS to be completed.

Updated software is available on the GRT website (www.grtavionics.com) . Follow the instructions in the Support, Software section to select and download the correct file for your EFIS.

A USB flash drive (memory stick) is supplied with your GRT Sport and is used to transfer files from your PC to the EFIS. The EFIS may not be compatable will all brands of USB flash drives, so test any flash drives prior to use.

Flash Drive (Memory Stick) Preparation:

1. Plug the flash drive into your computer. Windows XP and Vista should recognize it automatically. Earlier versions will require a driver.
2. The flash drive will appear as a removable disk. Use Windows Explorer to delete any files on the flash drive. The flash drive is ready to use.

Copy the newest SportUp.dat file to the main directory of the USB flash drive.

Installation on the EFIS display unit:

1. Go to the **SET MENU** by pressing the button corresponding to this item on the menu. This item is one of the last few items on the PFD page. Press the **NEXT** button to see more menu items.

2. Use the knobs to move the cursor to **Display Unit Maintenance** and push a knob to activate that menu.

3. Use the knobs to move the cursor to **Load EFIS Software** and push a knob to select the item.

4. Rotate the same knob clockwise to activate the **EFIS upgrade** page.

5. Insert the USB flash drive into the USB connector on the back of the display unit, or into the panel mount USB connector if you have one.

6. Wait for the EFIS to detect the USB flash drive and download files. The EFIS may take up to one minute to detect the USB flash drive. The light on the USB flash drive should blink faster when detected and when data is being copied. The light will blink slower when the operation is complete.
7. When the EFIS has completed copying files from the USB flash drive, the display unit will reboot.
8. Remove the USB flash drive.

9. When the display unit boots up, verify that the Power Up page displays the new EFIS software version.

AHRS Software Upgrade

1. Go to the **SET MENU** by pressing the button corresponding to this item on the menu. This item is one of the last few items on the PFD page. Press the **NEXT** button to see more menu items.

2. Use the knobs to move the cursor to **AHRS Maintenance** and push a knob to activate that menu.

3. Use the knobs to move the cursor to **Load AHRS Software** and push a knob to select the item.

4. Rotate the same knob clockwise to activate the **AHRS upgrade** page.

5. Insert the USB flash drive into the USB connector on the back of the display unit, or into the panel mount USB connector if you have one.

6. Wait for the EFIS to detect the USB flash drive and download files. The EFIS may take up to one minute to detect the USB flash drive. The light on the USB flash drive should blink faster when detected and when data is being copied. The light will blink slower when the operation is complete

   The progress of the update will be displayed. Typically 5-10 minutes will be required to update AHRS software. Upon completion, the display unit may erroneously report the AHRS failed to restart. Ignore this message. The AHRS should be running with its new software. The software version can be verified elsewhere on the AHRS maintenance page.

Chapter 7 LIMITATIONS

7.1 Attitude Heading Reference System (AHRS)

The AHRS is subject to an angular rate maximum of 200 deg/second. If this limit is exceeded, the **AHRS Unreliable** message will be displayed. The air data (airspeed and altimeter) will remain valid however, attitude data will not be.

The AHRS may take up to 180 seconds to align during initial startup. During the first 10 seconds after power-up the aircraft should remain motionless, after that you may move the aircraft as desired. The **Align** message will show on the screen with the time remaining for alignment. Once the process is complete the artificial horizon will display

AHRS/ Air Data computer software is independent of EFIS software. The software versions are designated by the form 0.XX to distinguish them from EFIS software.

The AHRS /Air Data computer system provides attitude, airspeed and altitude data that is not dependent on external data such as GPS to perform these functions. GPS data is not used to aid the AHRS, and thus the loss of GPS data will have no effect on the AHRS. The AHRS does use airspeed data (but not altitude data) to improve the accuracy of its attitude data. Loss of airspeed data will only slightly degrade the accuracy of the attitude data, and will not significantly alter the integrity of the data. Thus, the AHRS may be operated without an airspeed (pitot/static) connection. Inaccurate airspeed data could result in noticeably inaccurate attitude data during turns and for a short time after a turn. In IFR conditions this will be observed as a difficulty in holding a heading after a turn is completed.

7.2 Hardware

Maximum Angular Rate in one all axis simultaneously: 200 degrees/second

Maximum Indicated Airspeed: Per Label on PFD

Maximum Altitude: Per Label on PFD

Operating Voltage Range: Per Label on Display Units

Chapter 8 CALIBRATION

8.1 Altimeter Calibration

The accuracy of the altimeter can be adjusted using entries provided on this page to account sensor errors that may occur due to aging.

The adjustments are stored within the AHRS/Air Data Computer. This means that is not necessary to enter these corrections into other display units that use data.

8.1.1 Partial Altimeter Calibration – Correcting Altimeter vs Baroset

This calibration adjusts the relationship between the altitude display, and the barometric pressure setting. This calibration does not require an air data test set, and may be performed on an annual basis, or as needed as follows:

Position the aircraft at a location with a known elevation.

1. Turn on the GRT Sport and allow at least 5 minutes to elapse before continuing.
2. Obtain the current barometric pressure setting. This setting should be provided by the airport at which the airplane is located, or a nearby airport, and should be as recent as possible.
3. Select the **Altimeter Calibration** screen by selecting **SET MENU** from the button menu and **Altimeter Calibration** from this menu.
    1. Using the left knob, highlight the **Altimeter Calibration – OFF** selection.
    2. Toggle this to (**Initiate**)**ON**.
    3. Set the baroset to the currently reported altimeter setting.
    4. Select **Altimeter Bias**. Adjust the setting until the altimeter matches the airport elevation. (Note that there is about a 2 second delay until adjustments are reflected in the displayed altitude.)
    5. Use the buttons to exit.

Calibration is complete! Do not alter any other altitude settings. The altimeter calibration will be turned off automatically when this page is exited.

8.1.2 Full Altimeter Calibration – Using Air Data Test Set

This calibration adjusts the relation-ship between the altitude display, and the barometric pressure setting using an Alti-meter Test Set.

1. Turn on the GRT Sport and allow at least 5 minutes to elapse before continuing.
2. Connect test set to the pitot AND static ports of the AHRS.
3. Set the test set to sea level (0').

NOTE: Failure to connect the test set to the pitot connection will damage the airspeed sensor in the AHRS, and any mechanical airspeed indicators which are also connect to the pitot/static system under test.

4. Set the baroset to 29.92 on the GRT Sport display unit. Turn the right knob to set baroset.
5. From the display unit which contains the AHRS (PFD), select the **Altimeter Calibration** page in the **Settings Menu**
6. Verify the baroset is 29.92.

7. Use the left knob to select (blue box) and press the knob to highlight (white box) the **BIAS** field.
8. Temporarily adjust the **BIAS** on this page until the altimeter reads 0 ft.
9. Set the altimeter test set to 30,000 ft.'
10. Note the GRT Sport altimeter reading.
11. Calculate the scale factor as follows:

Calculate the Altitude Error as:
Altitude_Error =
GRT Sport_Altimeter_Reading with test set at 30,000 ft.

If the GRT Sport altitude is less than 30000 ft, the **Altitude Error** is negative.

Calculate the **Pressure Error** by multiplying the **Altitude Error** by 0.819. The result will be a negative number.

If the GRT Sport altitude is greater than 30000 ft, the **Altitude Error** is Positive.

Calculate the **Pressure Error** by multiplying the **Altitude Error** by 0.795. The result will be a positive number

The scale factor is then calculated as follows:

Alt Scale Factor = 42012 / (42012 + **Pressure Error**)

The result should be a number greater than 0.9744, and less than 1.0255

Set the **Alt Scale Factor** as calculated.

(Current GRT Sport software may show **ERROR** next to **Calibrate**. This can be ignored.)

12. Set the altimeter test set back to sea level (0 ft')
13. Set the **BIAS** so that the altimeter reads 0 ft.
14. Complete the calibration by setting the altimeter test set to each altitude listed on the calibration page (5000, 10000, 15000, etc.), and adjusting the corresponding entry until the altimeter reads this altitude.

The accuracy of the scale factor adjustment can be verified by noting a small altitude error (less than 200 feet) is observed with a zero correction at 30,000 feet.

15. Adjust the 30,000 foot correction until the altimeter reads 30,000 feet.
16. Exit the calibration page.
17. Calibration is complete.

If necessary, the **BIAS** adjustment can be made without affecting the other corrections at any time.

8.2 Magnetometer Calibration

Magnetometer calibration is required to achieve accurate magnetic heading readings. This calibration corrects for errors induced by magnetic disturbances local to the sensor, such as ferrous metal objects.

Before performing this procedure, the magnetometer location should be validated as follows:

> **Note:** The magnetometer must be installed according to the mounting instructions provided with the magnetometer.

8.2.1 Magnetometer Location Validation

Select the **AHRS Maintenance** screen by selecting **SET MENU** from the button menu and **AHRS Maintenance** from this menu, and locate **Magnetic Heading** field on this screen. (Do not use the heading data shown on the heading tape on the PFD is the gyro slaved

heading, which responds slowly to magnetic heading changes).

Observe this reading and verify it does not change by more than +/- 2 degrees while doing the following:

1. Turn on and off any electrical equipment whose wiring passes within 2 feet of the magnetometer.
2. Move the flight controls from limit to limit.
3. If the magnetometer is located within 2 feet of retractable landing gear, operate the landing gear.

If greater than +/- 2 degree change is noted, either relocate the magnetometer or offending wiring or metallic materials. Recheck.

Before performing the magnetometer calibration procedure, the approximate accuracy of the uncorrected magnetic heading data must be checked.

While the calibration procedure can remove errors as large as 125 degrees, accuracy is improved if the location chosen for the magnetometer requires corrections of less than 30 degrees.

8.2.2 To check the accuracy of the uncorrected magnetic heading:

1. Scroll to **Magnetometer Calibration**
2. Press knob to select
3. While on this page, rotate the airplane 360 degrees. A red graph will appear on this page showing the errors showing the calculated errors.

If errors of greater than 30 degrees are observed, this may be caused by magnetic disturbances near the magnetometers, such a ferrous metal, magnetic fields from electric motors, or if the magnetometer orientation is not the same as the AHRS. (For every 1 degree of misalignment between the magnetometer and the AHRS, approximately 3 degrees of heading error can be expected.)

If errors greater than 30 degrees are noted, either relocate the magnetometer or offending wiring or metallic materials. Recheck.

8.2.3 Calibration Procedure

> **NOTE:** The AHRS will not allow magnetometer calibration to be initiated if the airspeed is greater than 50 mph to prevent inadvertent selection while in flight. If calibration is successful, the existing calibration data (if any) will be replaced with the new corrections.

The **Magnetometer Calibration** page will guide you through this procedure with its on-screen menus.

The steps you will follow are:

1. Point the aircraft to **magnetic** north, in an area without magnetic disturbances, such as a compass rose.

   A simple means of pointing the airplane toward magnetic north is to taxi the airplane slowly and use the GPS ground track to determine when you are taxiing in a magnetic north direction. Make small corrections to the direction of travel of the airplane, and continue to taxi for several seconds for the GPS to accurately determine your ground track. The GPS cannot determine your track unless you are moving.

2. After the aircraft is positioned accurately, turn **ON** the GRT Sport. (If it

was already on, then turn it **OFF**, and then back **ON** again.)

3. Allow at least 1 minute for the AHRS to fully stabilize.
4. Activate the magnetometer calibration function by selecting the **AHRS Maintenance Page**, and highlighting the **Magnetometer Calibration** selection.
5. Change this setting with the knob to select the **Magnetometer Calibration** page.
6. Press **Start**.
7. Answer the question,**Yes.**
8. Verify the airplane is still pointed to magnetic north, and answer the question **Is the airplane, AHRS, and magnetometer pointed north?** with **Yes**.

A message will appear at the bottom of the screen indicating the system is waiting for the gyros to stabilize.

9. Wait until this message is replaced with the message, **Calibration in Progress**, and immediately (within 15 seconds) begin the next step.
10. Rotate the aircraft 360 degrees plus 20 degrees in a counter-clockwise manner (initially towards west).

The airplane does not need to be rotated in place, but simply pulled or taxied in a circle. The airplane must be rotated completely through 360 degrees, plus an additional 20 degrees past magnetic north, within 3 minutes after initiating the calibration. The airplane should be rotated slowly, such that it takes approximately 60 seconds for the complete rotation.

If calibration is successful, the AHRS will re-start itself automatically, and begin using the corrections. While re-starting, the AHRS data will not provide data, and this will result in the AHRS data disappearing from the display unit for about 10 seconds.

If calibration is unsuccessful, one of two things will happen.

1. It will exit calibration mode, and will show **Calibration INVALID - Maximum correction exceeded** if a correction of greater than 127 degrees is required. (**Invalid - OVERLIMIT** will be shown on the AHRS maintenance page next to the Magnetometer Calibration field.

A correction of greater than 127 degrees can be caused by incorrect mounting of the magnetometer, or location of the magnetometer too close to ferrous metal in the aircraft, or starting with the airplane not pointed toward magnetic north or magnetometer wiring errors.

2. If the airplane is rotated too rapidly, the calibration will not end after the airplane has been rotated 380 degrees. In either case, the calibration procedure must be repeated.

The accuracy of the magnetometer calibration can now be verified.

1. Point the airplane toward magnetic north.
2. Turn **ON** the AHRS (if already **ON**, turn it **OFF**, and then back **ON**).
3. Verify the AHRS (on **AHRS Maintenance** page) shows a heading close to north. (Small errors are likely to be a result of not positioning the airplane to the exact heading used during magnetometer calibration.)
4. Select the **Magnetometer Calibration** page. (Do not activate the calibration this time.)
5. Rotate the airplane through 360 degrees, and inspect the **Calculated error** graph (the red line) drawn on the screen.

The magnetic heading errors should be less to 5 degrees, and can typically be reduced to about 2 degrees. Accurate magnetic heading is required for the AHRS to display accurate heading data, and to allow accurate wind speed/direction calculations.

The graph will also show the correction stored in the AHRS as a green line. The green line will be within the +/- 30 degree range if the magnetometer was mounted in a good location, and was mounted accurately with respect to the AHRS.

The status of the magnetometer correction data is indicated by the field next to the **Magnetometer Calibration** setting on the **AHRS Maintenance** page, if the field has the message **(Change to open page)**, then valid data is stored within the AHRS.

Valid data means that the data is present, but the accuracy of this data is not assured. The accuracy is dependent on how carefully the user performed these steps.

Calibration is complete.

8.3 True Airspeed and Wind Calibration

The GRT Sport accurately calculates indicated airspeed via its measurement of the difference between pitot and static pressures.

Typical instrument errors are less than 2 mph at 100 mph, and diminish to less than 1 mph at 200 mph. It is not uncommon for airspeed errors to be observed however, as the pressures provided by the aircraft's pitot/static system does not always represent the actual static and impact pressures.

The GRT Sport provides a means of correcting the true airspeed that it displays in the PFD data box, and which is used in the wind calculation. Since the wind calculation is based on the difference between GPS groundspeed, and true airspeed, it is quite sensitive to true airspeed errors, and for some airplanes a significant improvement in the accuracy of the winds can be achieved by performing this calibration.

The GRT Sport does not provide any means to correct the indicated airspeed, as this would result in the GRT Sport showing a different indicated airspeed than other indicators that may be installed in the airplane.

The **AHRS Maintenance** page provides a **True Airspeed Corrections** selection. When selected, a correction table is shown, over-laid on the PFD screen. The table allows for up to 8 corrections. It is recommended that at least the following 3 airspeeds be used for the corrections: correction at the typical cruising speed, typical climb airspeed and typical approach speed. For example, with an RV-6, a good approach speed might be 80 mph with flaps at 1 notch. Additional corrections can be entered if desired, especially if TAS errors are noted that vary significantly with speed. Only one correction for a specific airspeed should be made.

To record a TAS correction:

1. Press any button or knob.
2. Press **NEXT** (more than once may be required)
3. Press **SET MENU** button
4. Scroll with either knob to **AHRS Maintenance**
5. Scroll to **True Airspeed Corrections**
6. Press knob to select
7. Turn knob to open calibration page
8. Select a blank table entry in the correction table using a knob.

If no entries are blank, then select an entry and press **Delete** to clear the entry. The **Start Cal** button will be displayed when the cursor box is on a blank entry.

9. Press the **Start Cal** button to begin.
10. Find a heading such that the ground track indicator is aligned with the heading indicator on the PFD or map pages within 5 degrees. This will result in the airplane flying directly into, or with the wind.
11. Establish the desired IAS for the correction. Do not change the power setting until the calibration is complete.
12. Press the **Ready** button.

The GRT Sport will average the data until the on-screen count-down timer reaches 0.

13. Maintain constant heading and altitude until the count-down timer reaches 0.
14. Turn to the reciprocal heading when prompted.
15. When established on this heading, at the same altitude and power setting as in step 11, press the **READY** button.

The data will be collected until the count-down timer reaches 0. The correction table will then display this correction.

16. Process is complete

If you feel that an entry is inaccurate, it may be deleted by selecting it with the cursor box using the knob, and pressing the **DELETE** button. You will be asked to confirm deletion of this entry before it is erased.

These entries can be saved using the **GRT Sport Settings Backup** selection on the display unit maintenance page. They may also be manually entered if desired using the **EDIT** function.

8.4 Flap/Trim Calibration

See **General Setup**, **Flaps and Trim Calibration**. This setting assumes electric flap/trim servos are installed. Follow the on screen instructions.

8.5 Fuel Flow Totalizer Calibration

The fuel flow totalizer (fuel quantity) can be set on the EIS engine monitor, or the GRT Sport display unit.

If the EIS is mounted in the instrument panel, it is used to set the fuel quantity whenever fuel is added to the airplane. This data will be transmitted to, and displayed on all display units to which it is connected.

If the EIS is not mounted in the instrument panel, the fuel quantity can be set on any display unit, but only if the fuel quantity in the EIS is reporting zero fuel. If the display unit detects a change in the fuel quantity reported by the EIS fuel flow function, it will use this data, overriding the user selection made on the display unit. By setting EIS fuel quantity to zero, it assures the EIS reported fuel quantity will not change.

The fuel flow calibration must be set in the EIS, via its **FloCal** entry. See *EIS* manual for more detail.

8.6 Two Display Unit Communication

The display units share information; this allows user selections that affect the entire system to affect all display units, such as the altimeter setting for instance.

The following items are updated in all display units whenever this data is changed in any display unit.

- Altimeter Setting

- Heading Selection
- Selected Altitude
- All autopilot modes and selections, including ARMing of approaches
- Navigation Mode
- Synthetic Approach On/Off
- Fuel Flow Totalizer
- Alarm Acknowledgements

Other data may also be shared between display units using the Inter-Display Link menu on the General Setup screen. See the section User Settings, **General Setup**, for more information.

CAUTION: If any display unit in the chain is inoperable, the display units will not be able to share information. The pilot must account for this down-graded mode of operation as necessary and expect data will not transfer between displays.

Chapter 9 APPENDIX A: SPECIFICATIONS

PHYSICAL

Display Case Size: 6.25”W x 4”D x 4.65”H
Face plate Size: 7.25” W x .375” D x 4.75”H
Unit Weight: 2.25 lb.

Magnetometer Size: 5.125” W x 2.8”D x 1.125” H
Unit weight: .25 lb

EIS Size: 5.125” W x 2.375” D x 2.375” H
Face Plate Size: 5.94”W x .125”D x 2.75”H
Unit Weight: .9 lb.

POWER

Input: 12 Vdc (9-18V, 1.5 amps)
28 Vdc (optional) (18-36V, 1.0 amp)

INTERFACES

RS-232 serial

Chapter 10 APPENDIX B: FAQ

What is the difference between the GRT Horizon and Sport?

The Horizon is built for Instrument Flight Rules (IFR) flying. It accepts a wide variety of radios, gps and autopilots. The autopilot command functions built into the Horizon allow for lateral and vertical coupling to the autopilot. This permits "hands-off-stick" flying much like current and future technology airliners.

The GRT Sport is much like the Horizon although tailored to the Visual Flight Rules (VFR) pilot. It will communicate with a Garmin SL30/40 radio and provides lateral autopilot commands. The AHRS/Air Data computer is physically inside the Sport instead of external like the Horizon. The Sport has limited inter-display link features.

If you like to fly hard IFR with an automated cockpit your choice will likely be the GRT Horizon. If you fly on fair weather days mostly with occasional light IFR your choice will likely be the GRT Sport.

What do I do if I want to upgrade to the Horizon?

All we require to upgrade to the GRT Horizon is the cost difference, send the Sport back and we will ship a Horizon in its place.

What do I need to upgrade to internal GPS?

All we require is the cost difference for the internal GPS option. Send us the Sport display unit and we will return the Sport with internal GPS installed and antenna.

Why a wide format display?

The wide format of the display was chosen to allow a more natural sense of the horizon, this especially useful for low-time IFR or VFR pilots. The wide format is necessary to allow split screen displays. It also allows for airspeed and altitude tapes to include analog and digital representations.

Why was the overall size chosen?

The overall size is such that two will fit, stacked on top of each other, in the RV and similar panels. This allows a great deal of flexibility, yet is still large enough to be easily readable.

Why not save the cost of the magnetometer, and make this optional?

Without a magnetometer, GPS data is required for calculation of attitude. Bad or loss of GPS data would cause unexpected loss of attitude data, and would reduce the integrity of the attitude data, and would reduce the performance of the GPS/AHRS cross-check.

Why not build the EIS into the GRT for its engine monitoring functions?

The EIS provides a full time, easy-to-read display of engine data. This makes a single GRT display unit completely practical. Without the EIS, a second GRT display would be required to allow full time display of engine data.

Engine monitoring requires numerous connections to the engine and its sensors. Each of these connections is exposed to high levels of electrical noise, and has the potential of electrical faults introducing unexpected voltages to them. Bringing signals of this type into the GRT has the potential for adversely affecting the GRT, and thus reducing its integrity.

The EIS provides a convenient backup for altitude and airspeed data if desired.

For multiple display screen configurations, the EIS may be remotely mounted.

How does this GRT compare with the other EFIS systems?

There are 3 “levels” of differences.

The First Level

The obvious differences are the size and functionality.

This size of the display unit is large enough to allow the artificial horizon to look "natural", that is, like a synthetic view of the outside world (complete with airports and obstructions), and still have room for both tapes and large digital displays of airspeed and altitude.

At the same time, the size is is small enough to allow multiple display screens. Since each multi-function display unit can display any data (primary flight data, moving map, graphical engine data, or a split screen of any 2), the use of 2 display units provide twice as much viewable data, while at the same time, adding redundancy. This also allows for a simple means to expand your system to meet future avionics needs.

The functions of our GRT are extensive, including major functions such as integrated navigation/attitude displays on the wide-format primary flight display, graphical engine monitoring, moving map, and also including interfaces to the autopilot, localizer and glideslope inputs, with planned growth for weather and traffic.

Clearly the functionality and size is far beyond that provided by other units. The difference in architecture, that is, the ability to use multiple display units independently, vastly distinguishes us from single screen systems. Those familiar with commercial jets may notice a similarity between the architecture (and functionality) our equipment, and that of commercial jets. This is no accident, as the chief engineer's background included 10 years experience in the aerospace industry.

This first level is where the functionality that results in efficient and safe automation of the cockpit is built in.

The Second Level

These differences are more subtle. They include such things as wide-temperature range operation, direct sunlight readability and hardware designed specifically for aircraft use. The design of this hardware is based on the design principles developed over 12 years of experience with the Engine Information System (EIS) line of engine monitoring and more than 20 years of aerospace experience. This results in a robust design that has excellent tolerance for real-world exposure to wiring errors, radio and electromagnetic fields, etc.

By comparison, other manufactures will use displays not viewable in direct sunlight, or their system may operate only over a limited temperature range, or may be limited by low maximum angular rates, incomplete interfaces, lack of built-in test functions or data validation, and further may operate in "unconventional manners".

This second level is the level where the quality is designed in.

The Third Level

These details are usually unseen, but are what distinguishes aviation equipment from non-aviation equipment. It includes not only the

selection of components suitable for use in an aircraft environment, but also relies on a failure modes and effects analysis. This analysis results in design features and functions (such as built-in-test functions) that add integrity. High integrity means a low probability of an undetected failure of any of the flight critical data provided to the pilot.

This third level is the level where safety is designed in.

Conclusion

In the simplest terms, the difference between us and the others is the engineering and flying experience upon which our system is designed. The GRT Sport provides aerospace grade design, at kit plane affordable prices.

What are the limitations of the AHRS?

When flying close to the magnetic north or south poles, the AHRS must revert to using GPS track data, instead of magnetic heading data. This reduces the integrity of the AHRS calculation of attitude, and the effectiveness of its GPS/AHRS cross-check. The GRT will alert the pilot to this degraded mode of operation. Obviously, this is unlikely to affect most users.

In theory, it is possible for the AHRS to be affected by vibration, especially if resonances (flexibility) exist in the mounting of the GRT to the airplane. A simple flight test is performed to check for this possibility. We have not seen this problem occur in our testing, but in theory, it is possible.

The maximum angular rates are 200 degrees/second in roll, pitch, and yaw simultaneously.

What backup instruments are recommended for a single GRT Sport installation?

For VFR flight, the addition of airspeed is suggested.

For IFR flight the Sport ADAHRS replaces the function of the traditional six-pack but does not replace the redundancy, therefore at least two other attitude sources are recommended. These can include a turn coordinator and autopilot. As well as an airspeed indicator, and altimeter as a minimum, but the pilot should consider their flying skills when configuring their cockpit. For dual electrical bus installations, the EIS can be equipped to serve as a backup airspeed indicator, and altimeter.. This has the added benefit of automatic cross-checking against the GRT Sport's airspeed and altitude.

Why is the GPS database free?

Our database is based on U.S. government data, provided to us at no charge.

Will a database be available for airspace outside of the United States?

Yes. The only difference regarding the database outside of the US is that it will only include airports with runways of 3000 feet or greater.

Can I use a Nav/Com other than a Garmin SL30 with the Sport?

The GRT Sport interfaces with the SL30 exclusively. There are no analog inputs for other radios. You may use other Nav/Com for nav data however you will need a CDI head like a GI106A to show course deviations.

Can I use a low-cost handheld GPS with the GRT Sport?

Yes. Even low-cost GPS receivers include the required NMEA 0183 output.

Are GRT settings user-selectable?

Yes. Practically all data may be displayed in your choice of units, including the barometric pressure setting, temperatures, fuel quantity, etc.

What is the most important feature of the GRT Sport?

The most feature of the GRT Sport is the high integrity AHRS that is not GPS dependent. What good are attitude data, and the GRT, if you can't trust it?

Why doesn't the GRT include an autopilot function?

While it is possible for the GRT to also perform an autopilot function with the addition of a control panel, and appropriate servos, we intentionally choose to interface to stand alone autopilots. A stand-alone autopilot does not use the attitude data from the GRT, and thus is effectively another source of this data. If the autopilot was driven from the GRT attitude data, an undetected failure of this data would result in the autopilot following the bad data. This would make detecting the failure more difficult. While undetected attitude failure is unlikely with our system, the consequences of such a failure are potentially fatal. In effect, the autopilot serves as another source of attitude data, and a good argument could be made for choosing an autopilot over a backup attitude indicator. (A turn coordinator would still be required for IFR flight)

Conversely, with the independent autopilot and GRT attitude combination we have chosen, a failure of either the autopilot, or the GRT attitude data would result in an obvious disagreement, and could trigger an GRT unusual attitude warning. Safety is greatly enhanced.

Also, autopilot designs are far from trivial. The safety concerns, and control laws which dictate the response of the autopilot require a degree of expertise that we feel is best left to the experts.

Why do you recommend the TruTrak autopilots?

We felt the design of the TruTrak was excellent in terms of safety, and performance. We especially liked the safety considerations in the design of the servos. More obvious to the pilot, the control laws are based on the extensive experience of the designer, Jim Younkin, which result in excellent performance in smooth air or turbulence. In the same way that we have developed extensive experience in instrumentation, TruTrak has extensive experience in autopilots. Other autopilots work well with the Sport also. Some may require a GPS-coupler which converts the digital data to analog used by the autopilot.

What will be your policy on revisions to the software and hardware systems?

Software updates are available via the www.grtavionics.com website at no cost. We do not have a policy for hardware revisions.

Can non-TSO instruments be approved for IFR flight in an experimental aircraft?

Yes.

How often does the GRT update the GPS map?

Our displays are gyro-stabilized, so our map moves smoothly when you turn, no matter how slowly or quickly your GPS updates. Our

screens update at high rates, so everything appears smooth on our screens...no jerks or jumps. This makes a significant difference when rolling out to capture a new ground track on the moving maps, as you don't have to guess or anticipate what the map will look like at the next 1 second update..

What provides the land and airspace data (database)?

We have our own database derived from US government databases.

Is the HITS offset on the screen because you are crabbed for wind?

Yes, exactly. It "grows" up and out of the runway, which is obviously a ground-based reference. The primary flight display is shown in **Heading Up** mode, which is the preferred mode, as this makes the view on the GRT match the view out the window. Thus, the difference between the heading up centered display and the ground-based runway guidance is the crab angle. This means that the approach is flown by maneuvering the airplane so that the flight path marker (which represents your path through space) is centered in the HITS. Even without the flight path marker displayed, interpreting the HITS is very natural, as it is identical to the visual clues you use when you look out the window and fly the airplane to the runway in the presence of a cross-wind. You instinctively develop a sense of the direction of travel of the airplane through space when you look out the window, and the flight path marker is a precise indication of this point. The flight path marker is commonly used on head-up displays in fighter aircraft.

If so, what happens if the wind is stronger - does the HITS go off screen?

It would, except that we apply "display limiting". This means we alter the position of all ground based symbology to keep the HITS and runway on the screen.

What is the sight picture if you are doing a circling approach or a close in base leg?

You see the HITS as though it was a tunnel projected up from the ground. The HITS will not appear on the screen if it is out of view, unless it is out of view due to a strong-cross wind. We will be adding guidance to bring you to the top of the HITS so that we guide you to the vicinity of the airport, and then provide steering to get you to top of the HITS. This is not trivial however.

Does the GRT have a "Quick Erect" function?

No. The only reason to have such a function is if the attitude information was to sometimes become corrupted. The attitude data provided by our system is of very high integrity, and there is no need for a "quick-erect" function. Note that even if the airplane is continuously performing turns and/or aerobatics, the attitude data will remain accurate.

What happens if the AHRS is turned off in flight?

It would be unusual to turn off the AHRS in flight, as it is the primary source of attitude data. If it is turned off, the airplane must be flown as steady as possible for the first 10 seconds after power is re-applied. The plane can then be flown in any manner, and the AHRS will begin providing attitude data within a minute or two.

Chapter 11 APPENDIX C: Troubleshooting

The Troubleshooting section gives aid to common installation or use questions.

Terrain

If the GRT Sport is unable to show Terrain data you may see one or more of these flags. This list will help in correcting in the Terrain data being displayed or not.

- **DISABLED** -- Terrain was disabled in the SET MENU but is still selected on the SHOW button.
- **NOT READY** -- The display is busy loading other databases.
- **Waiting for USB** -- The display did not find terrain on a flash card, and is waiting for a USB flash drive to be inserted. A USB flash drive may take up to a minute to be detected.
- **No database** -- A terrain database was not found on any storage device. The display will stop searching until the next boot.
- **Loading** -- The terrain database integrity is being checked and the index is being loaded into memory. The time this requires depends on the size of the database and how busy the display is. The terrain will start up faster while on the Power Up and MAP pages.
- **OK** -- The terrain database has completed loading. Terrain will be drawn and the terrain alarm activated if requested.
- **Low memory** -- Some part of the terrain database was not able to load because the display is low on memory. This message should not normally be seen, but is possible if several memory intense features are all active at the same time. Weather, terrain, large map ranges, and DEMO recording can consume large amounts of memory. The display will attempt to use any parts of the terrain that could be loaded. Report this message to GRT.
- **Bad database** -- The terrain database has been damaged or is not compatible with the display software.
- **ERROR** -- The display has detected a failure in its terrain processing and has disabled all terrain functions. Terrain will not be available until the next boot. Report this message to GRT.

AHRS/Magnetometer-Comm Interference

Most problems encountered with attitude or heading after installation is the placement of the AHRS and Magnetometer near ferrous metals or com coax cables. Most of these problems can be avoided if the Installation Guide is followed.

Wire bundles from the AHRS or magnetometer must be kept away from com coax cables. It is suggested to run com coax on one side of the fuselage and AHRS/Mag wire bundles on the other. If the coax must pass by the wire bundles it is suggested that it be made perpendicular to the wire bundle.

See grt Sport EFIS Installation Guide for more detail.

Chapter 12 GLOSSARY

ADC Air Data Computer

AHRS Attitude Heading Reference System

ALT Altitude

AOG Aircraft On Ground

ARINC-429 Aeronautical Radio Incorporated Interchange- Protocol 429

AVG Average

Button Five white buttons (See soft key)

CDI Course Deviation Indicator

EFIS Electronic Flight Instrument System

EHSI Electronic Horizontal Situation Indicator

EIS Engine Instrument System

ENG Engine group

FPM Flight Path Marker

If you are not familiar with Flight Path Markers and their use, there are a number of references on the internet. This Van's Airforce thread offers a good explanation:

http://www.vansairforce.com/community/showpost.php?p=195475&postcount=11

This YouTube video shows how to make a landing using Flight Path Marker and the affect of wind:

http://youtube.com/watch?v=2Y4AgKOpUco

fpm Climb Rate Feet Per Minute

FTM Flight Track Marker

GND Ground

GPS Global Positioning Satellite

GPSS GPS Steering

GRT Grand Rapids Technology

GS Ground speed

HITS Highway In The Sky (Synthetic Approach)

HRS Hours

HSI Horizontal Situation Indicator

Knob Rotary Encoder (two - left and right)

LTG Lightning

ILS Instrument Landing System

MAP Moving Map group

mpg Miles per gallon

mph Miles Per Hour

NAV Navigational signal

NDB NonDirectional Beacon

OROCA Off Route Obstacle Clearance Altitude

PFD Primary Flight Display group

RMI Radio Magnetic Indicator

Rotary Encoder see Knob

SAP Synthetic Approach **(**See HITS)

SFC Specific Fuel Consumption

Soft key Five white soft keys (See Button)

TAS True airspeed

TRK Track

Va Design Maneuvering Speed

Vc Design Crusing Speed

Vd Design Diving Speed

Vf Design Flap Speed

Vfe Maximum Flap Extension Speed

Vne Never-exceed Speed

Vno Maximum Structural Cruising Speed

VOR Vhf (Very high frequency) Omni-directional Range

Vs Stall Speed

Vx Speed for Best Angle of Climb

Vy Speed for Best Rate of Cli